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MOLLUSCA OF THE SOUTHWESTERN STATES. II.

BY H. A. PILSBRY AND J. H. FERRISS.

The present paper deals with mollusks of Texas, New Mexico and Arizona, collected chiefly by the authors in 1903, and not included in the first paper of this series.¹ No attempt has been made to present complete faunas; but in connection with the previous paper, about all the reliable data extant upon the snail faunas of the Chiricahua and Huachuca ranges in southeast Arizona and the eastern and southern borders of the Lower Sonoran area in Texas will be found herein.² It has not been thought expedient to repeat data elsewhere accessible.

For the student of molluscan distribution, the life zones of the United States as mapped by Dr. Merriam³ emphasize the secondary and not the primary facts of distribution. The laws of temperature control, which he has developed with keen insight, do not define transcontinental zones of primary import zoologically. These zones are secondary divisions of vertical life areas of which the molluscan faunas were evolved in large part independently. The Sonoran fauna is probably intermingling more now with that of eastern North America than at any former time, at least so far as such sedentary forms as land mollusks are concerned.

Similar conclusions have been reached by Mr. A. E. Brown in dealing with Texan reptiles.⁴ The results of his study "establish three facts, hitherto not wholly free from uncertainty: first, that the boundary between the Austroriparian and Sonoran reptilian faunas lies approximately between the 96th and 98th meridians of longitude in Texas; second, that the restricted Texan district of Cope is not Austroriparian but Sonoran; third, that transcontinental zones of distribution cannot be maintained in the Medicolumbian region for reptiles."

¹ *Proc. A. N. S. Phila.*, 1905, p. 211.

² Some New Mexican records, chiefly from material collected by Prof. T. D. A. Cockerell in the upper Pecos valley, are added.

³ Biological Survey, U. S. Dept. of Agriculture, Bulletin No. 11, Map. *North American Fauna*, No. 25, Plate I.

⁴ Texas Reptiles and their Faunal Relations, *Proc. A. N. S. Phila.*, 1903, pp. 543-558.

Post-Glacial Nearctic Centers of Dispersal for Reptiles, *Proc. A. N. S. Phila.*, 1904, p. 464.

“ . . . the community in reptiles between the Sonoran and the Austroriparian is much less than that between the Sonoran and the Central; it is, in fact, limited to widely ranging genera . . . the separate identity of these two faunas [Sonoran and Austroriparian], as far back as they can be traced, confirms the conclusion already reached, from their present distribution, that the association of the Sonoran with the Austroriparian into one transcontinental zone is unnatural.”

This terse statement only requires the substitution of “mollusks” for “reptiles” to serve as a summary of the results of our present investigation. In land mollusks, as in reptiles, the Sonoran types have pushed farther into the humid Austroriparian than the eastern types into the Sonoran area. *Bulimulus* and the *texasiana* group of *Polygyra* are cases in point; while Eastern subgenera of *Polygyra*, and practically all Austroriparian forms except the minute, widely ranging genera, stop short at the rise marking the approximate limit of the Cretaceous formation and the Sonoran area in Texas. The common boundary of the Austroriparian and Sonoran, while surprisingly sharp for continuous areas, is deeply accidented by the river valleys, which carry very narrow Austroriparian ramifications into Sonoran borders. Thus, along the San Marcos river in Hays county, the Guadalupe river in Comal county, and the San Antonio river in Bexar county, an Austroriparian fauna with such Eastern forms as *Omphalina*, *Polygyra thyroides*, *P. monodon fraterna*, *P. auriformis*, *P. roemeri*, *Bulimulus d. liquabilis*, etc., is found, while the fauna on the bluffs or away from the streams is frankly Sonoran. Farther southwest, the Austroriparian forms are wholly wanting, even where moist local conditions prevail, as in the immediate vicinity of the streams of Val Verde county.

A list of the forms characteristic of the eastern or lower portion of the Sonoran in Texas (Texan District of Cope) follows:

<i>Praticolella berlandieriana</i>	<i>Strobilops l. texasianus</i>
<i>Thysanophora hornii</i>	<i>Zonitoides nummus</i>
<i>Polygyra hippocrepis</i>	<i>Vitrea indentata umbilicata</i>
<i>Polygyra texasiana hyperolia</i>	<i>Vitrea dalliana roemeri</i>
<i>Polygyra t. texasensis</i>	<i>Euconulus chersinus trochulus</i>
<i>Polygyra mooreana</i> ⁵	<i>Helicodiscus eigenmanni</i>
<i>Bulimulus d. mooreanus</i>	<i>Planorbis carus</i>
<i>Bulimulus d. ragsdalei</i>	<i>Planorbula obstructa</i>

⁵ This species extends somewhat into the Austroriparian.

<i>Bulimulus d. pecosensis</i>	<i>Goniobasis comalensis</i>
<i>Bulimulus alternatus mariæ</i>	<i>Paludestrina seemani</i>
<i>Holospira roemeri</i>	<i>Paludestrina diaboli</i>
<i>Holospira goldfussi</i>	<i>Ammicola comalensis</i>
<i>Microceramus texanus</i>	<i>Cochliopa riograndensis</i>
<i>Euglandina singleyana</i>	<i>Potamopyrgus spinosus</i>
<i>Bifidaria procera cristata</i>	<i>Valvata micra</i>

Nine genera of this list are not known to occur in the Austro-riparian or humid region of Texas. For list of the latter fauna, the student is referred to the catalogue of Mr. J. A. Singley, cited below, from which a long list of Austroriparian forms of Eastern type may readily be compiled.

The first list of Texan mollusks of any extent was published by Römer in his excellent work on Texas, 1849. Numerous references to the terrestrial mollusks will of course be found in Binney's successive volumes. In 1878 Mr. A. G. Wetherby⁶ published some notes on the forms he found in eastern Texas (*American Naturalist* for 1878, pp. 184, 254). The principal source of information, however, is Mr. J. A. Singley's Contributions to the Natural History of Texas, part I, Texas Mollusca, published in the *Fourth Annual Rep. Geol. Survey of Texas*, 1893. In this list Mr. Singley has included with the records of his own extensive collecting, others from many sources, so that the records are of unequal value. The Texan list stands much in need of revision and a good many names thereon are doubtless to be rejected, either because the forms do not occur in Texas, as in the case of *Ampullaria*, or because of wrong identifications; yet the work cannot be done until resident naturalists take it up.

HELICINIDÆ.

Helicina orbiculata tropica 'Jan' Pfr.

Texas: San Marcos, Hays county; Comal county, around New Braunfels; San Antonio, Bexar county; two miles north of Hondo, Medina county; Del Rio, Devil's river and High Bridge of the Pecos, Val Verde county.

Some colonies are all white; others are mingled with red or blue shells.

HELICIDÆ.

Praticolella berlandieriana (Moric.). Figs. 1, 2.

Texas: San Marcos, Hays county; Guadalupe river above New

⁶ By error Mr. Wetherby's name was printed "W. G. Weatherby."

Braunfels, Comal county; San Antonio, Bexar county; Hondo river, two miles north of Hondo, Medina county; Del Rio, Val Verde county.

Mr. Ferriss took some thin, translucent specimens, 8 x 10 mm., at Smithville. The shell varies from 9.8 to 11.7 mm. diam. The pub-

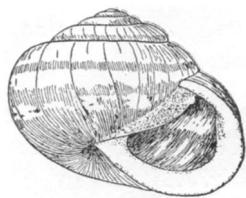


Fig. 1.

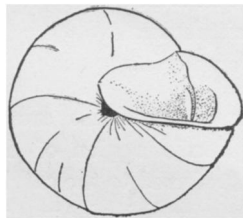


Fig. 2.

lished figures do not show that there is frequently a short lamellar tooth or callous on the parietal wall near the suture, a short distance within, as shown in the figured specimen from the Guadalupe river near New Braunfels.

***Thysanophora hornii* (Gabb).**

Texas: Hondo river, near Hondo, Medina county; Rio San Filipe, near Del Rio; Devil's river, west of Del Rio, and Pecos river at the High Bridge, Val Verde county, all in river drift.

New Mexico: Florida mountains, near Deming, Grant county.

Arizona: Cochise county; Cave creek canyon in the Chiricahua mountains; Fort Bowie; drift of San Pedro river at Benson, and Manilla mine, at the west end of the Huachuca mountains.

This small species is a typical *Thysanophora*, closely related to the type of the genus. It varies but little throughout its extensive range, unless it be in the cuticular lines and hairs, which are worn off of the river-drift specimens. It has not before been reported in this country from east of Cook's, Grant county, N. M. Our collection of 1903 extended its known range in the United States more than 500 miles eastward, to the border of the Staked Plains in central-southern Texas. Further localities in Arizona are given in *Nautilus*, XII, p. 99.

In Mexico, *T. hornii* has been collected at Topo Chico, near Monterrey, Nuevo Leon, and at Victoria, Tamaulipas (*Proc. A. N. S. Phila.*, 1903, p. 763). It is therefore one of the widely distributed species of the States both north and south of the international boundary in the Sonoran area.

***Polygyra auriformis* (Bld.).**

Helix auriformis Bland, Ann. Lyc. Nat. Hist. of N. Y., VII, p. 37 (1858).

? *Helix sayii* Wood, Index Testaceologicus, Suppl., p. 22, pl. 7, p. 34 n (1828).

Texas: Galveston (J. H. Ferriss); Calhoun county (Hubbard);

Austin and San Antonio (Pilsbry, 1885); along the Guadalupe river, three or four miles above New Braunfels (Ferriss and Pilsbry). Singley adds the localities Bastrop and Burleson counties. It is an Austro-riparian species which reaches into the borders of the Lower Sonoran area along the river bottoms.

While the identity of Wood's *H. sayi* with *auriformis* is not established with sufficient certainty to make a substitution advisable, in our opinion, yet there can be no doubt that Wood had either that species or one of its immediate allies. *Helix sayi* of Binney, 1840, being a homonym, may be changed to *Polygyra sayana* (*Terrestrial Mollusks*, III, pl. XXIII).

***Polygyra hippocrepis* (Pfr.).** Figs. 3, 4.

The known range of this curious snail is exceedingly restricted. It has been found only near New Braunfels, in Comal county, Texas. We found it in abundance in April, 1903, on the west side of the Guadalupe river about four to six miles north of New Braunfels, under stones near and at the foot of the bluff, with *Holospira goldfussi*. Another place much nearer the town is on the rocky wooded hillside above the springs of Comal creek, where we found a few living ones. This place is just beyond the pleasure gardens.

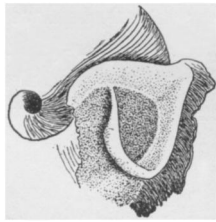


Fig. 3.

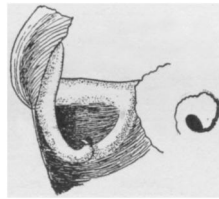


Fig. 4.

The structure of the aperture of *P. hippocrepis* has never been fully described or figured. The parietal tooth is not V-shaped as in other *Polygyras*, but U-shaped, hence the name *hippocrepis*—horseshoe. There is an internal tubercle on the columella, as in *P. mooreana*. The upper and lower lip-teeth enter and arch towards each other, forming a U-shaped curve, which stands close to but a little deeper than that formed by the parietal tooth. Where the two entering teeth join there is a notch and a delicate slender hook with the point curved towards the adjacent basal wall projecting forward. The immersion of the originally lower lip-tooth gives room for a secondary callous ridge along the basal lip, as shown in fig. 4.

These structures form in their way a more perfect barrier perhaps than that produced by other means in *P. auriculata* and *uvulifera*. The species stands isolated at present. It is perhaps an aberrant and highly evolved relative of the Tennessee-Arkansas group of *P. jacksoni*, etc.

Polygyra texasiana (Moricand). Pl. V, figs. 16, 17, 20.

Specimens of typical *P. texasiana* were taken by us in Hays, Comal and Bexar counties, Texas. Ferriss took it at Galveston. The type locality is "Texas." In this widespread form the last two whorls are strongly rib-striate above, the riblets rapidly diminishing on preceding whorls; the embryonic whorl is smooth and glossy. The ribs are strongest just behind the lip, and here continue upon the periphery or to the base, which is elsewhere nearly smooth or merely rippled. Fresh shells show a reddish peripheral band on the pale brownish-corneous surface. Specimens figured are from the west side of the Guadalupe river above New Braunfels, Texas. Alt. 5, diam. 11 mm.

Along the Rio Grande *P. texasiana* occurs with transition forms to *P. t. hyperolia*. See below.

Form with striate base. In some localities the ribs of the upper surface continue upon the base (pl. V, figs. 18, 19, Calhoun county, Texas), the other characters being unchanged. There are transitions to the normal sculpture of *texasiana* in some specimens, and we do not think it desirable to distinguish this form at present by a special name. Its distribution must be more fully worked out than we have been able to do. Calhoun county is on the Gulf coast near the southern angle of the State.

P. texasiana hyperolia n. subsp. Pl. V, figs. 13, 14, 15.

Shell more depressed than *texasiana*, glossy, *very finely striate, almost smooth, above and below*, with several riblets behind the lip-constriction. Uniform brownish-corneous or paler beneath, without a peripheral band. Aperture smaller and slightly more oblique than in *texasiana*. Alt. 4, diam. 9.3 to 10 mm.

The type locality is the high land west of Devil's river. This is the common *Polygyra* along the Rio Grande in Val Verde county, extending north and northwest. The specimens from down the river, at Hidalgo, . . . county, and Laredo, Webb county (collected by Singley), are either *texasiana* or transitional between *texasiana* and *hyperolia* in sculpture. At Del Rio, along the Rio San Felipe, Ferriss and I found still the *texasiana* and transition forms.

On the high land west of the Devil's river, Val Verde county, we found *hyperolia* in some numbers, under prostrate Yucca trunks and

sometimes concealed in the shelter of the downward-drooping dead leaves on standing Yuccas. From this region they have been washed into the Devil's river, where bleached shells are abundantly found in the drift débris.

We also took specimens in the high land along the Pecos river, near the High Bridge (Viaduct, on some maps), east of the river, and in drift débris in the canyon.

In the interior counties of Texas we took specimens in the drift of the Hondo river, Medina county, about two miles north of Hondo.

Much farther northward Mr. Ferriss found *hyperolia* at Colorado City, Mitchell county, Texas.

In New Mexico Prof. J. D. Tinsley collected it on South Spring creek, near Roswell, in the Pecos valley, where it occurred fossil in a bed of white marl, three to four feet below the surface. It is not now found living in that locality. We are indebted to Prof. Cockerell for these specimens.⁷

P. t. hyperolia varies about as much as *texasiana* in size. Specimens from west of Devil's river measure from 3.8 x 8 mm., with $4\frac{1}{2}$ whorls, to 4.2 x 11 mm., with 5 whorls.

This variety is not the *Helix* (*Polygyra*) *tamaulipasensis* of Lea, which is typical *P. texasiana*, as I have ascertained by a comparison of the type kindly made for me by Dr. W. H. Dall.

Polygyra texasiana texasensis (Pils.). Pl. V, figs. 11, 12.

Polygyra texasensis Pils., Nautilus, XVI, p. 31, July, 1902.

Similar to *P. t. hyperolia* in the depressed shape and smooth surface, without riblets above; but decidedly larger, with about $5\frac{1}{2}$ whorls, the umbilicus broader than is usual in the other forms of the species.

Alt. 5.2, diam. 12.5 mm.

Alt. 5.8, diam. 12.5 mm.

Alt. 5.8, diam. 13.7 mm.

Colorado City, Mitchell county, Texas; types collected by James H. Ferriss in 1902, No. 83,258, A. N. S. Phila.

This is a large edition of *P. t. hyperolia*, and further collections from the almost unknown northwestern half of Texas are needed to determine whether it is really distinct enough from that subspecies to call for recognition of the latter by name. In the large series of *hyperolia* collected there were, however, no forms as large as *texasensis*.

Polygyra mooreana (W. G. Binn). Pl. V, figs. 4-10.

This species stands close to *P. texasiana*, but the shell is smaller than

⁷ Reported as *P. triodontoides* in *The Nautilus*, XIII, November, 1899, p. 84.

any but the smallest *texasiana*, and with about the same number of whorls (5 to $5\frac{1}{2}$) appears more closely coiled. It is constantly distinct by the elongated columellar tubercle within the last whorl (shown in fig. 9). This tubercle seems to be what Binney erroneously describes as "an internal transverse tubercle on the base of the shell"—an expression which would lead one to expect such a structure as that found in the *Stenotremas*. Binney states that the color is "white," but fresh shells are brownish-corneous, a little paler and somewhat transparent at the base. The diameter varies from 6.5 to 8 mm. Variation in the degree of elevation is shown in the figures.

P. mooreana was originally described from Washington county, Texas. We took specimens at Smithville, Bastrop county, San Marcos, Hays county, around New Braunfels, Comal county (figs 4-7), and on the Hondo river north of Hondo, Medina county (figs. 8, 9, 10), everywhere in copious quantity. There are also specimens before us from Washington county, Belton, Fort Worth, Waco, Austin and Lee county. Further records are given by Mr. Singley in his valuable catalogue. It was taken at Galveston by Ferriss.

Polygyra mooreana tholus (W. G. Binn). Pl. V, figs. 1, 2, 3.

Larger than *mooreana*, with the last whorl far more openly coiled below, exposing more of the penultimate whorl in the much wider umbilicus. Specimens from Washington county measure:

Alt. 5.5, diam. 11, width of umbilicus 4.2 mm.; whorls 7.

Alt. 4, diam. 8.2, width of umbilicus, 3 mm.; whorls 6.

This form holds such a relation to *P. mooreana* as *P. d. sampsoni* to *P. dorfeuilliana*, being very openly coiled beneath, with a deep and very long groove on the last whorl within the umbilicus. The internal ridge is like that of *P. mooreana*. It seems to be comparatively local in distribution and is certainly rare. We have never seen a fresh specimen. It was described from Washington county, Texas, the locality of the specimens figured. It is in the collection of the Academy also from Calhoun county. Ferriss took a few specimens at Galveston, and Singley found it in Fort Bend and Brazos counties. Von Martens reports a worn specimen found by Friedel at Vera Cruz, Mexico.

Polygyra roemerii (Pfr.).

Smithville, Bastrop county, Texas (Ferriss); San Antonio, Bexar county (Pilsbry and Ferriss); near New Braunfels, Comal county, one specimen (Pilsbry).

BULIMULIDÆ.

The genus *Bulimulus* in Texas has caused much perplexity to students. Many and diverse have been the views held as to the rank

and identity of the several forms. Several times since the first visit of one of us to Texas, in the winter of 1885-86, they have been carefully studied anew, with each time larger materials and better knowledge of the country. To the specimens already in the museum of the Academy about 1,000 were added by our expedition of 1903, from central and western Texas and Indian Territory.

The series is divisible into two species, *B. dealbatus* and *B. alternatus mariae*; the first further split into numerous local races or subspecies. The typical forms of *B. alternatus* and *B. schiedeanus* do not, so far as we know, extend into Texan territory; both were described from Mexico where they range over a large area. *B. patriarcha* W. G. B., unquestionably a form of *schiedeanus*, was also described from Mexico (Buena Vista), and we have seen no specimen of it from within our borders.⁸

In the United States, *Bulimulus* has not been found west of the neighborhood of El Paso. We know nothing of what forms live in the State northwest of a line from Austin to San Antonio, or north of the Southern Pacific Railroad from San Antonio westward to El Paso. Beyond some extension of the ranges of *B. dealbatus mooreanus* and *B. alternatus mariae*, little is to be expected from the great unknown area.

The following forms are now recognized:

1. *B. dealbatus mooreanus* W. G. B., Pfr. Arid region of central and south Texas.
2. *B. d. liquabilis* Rve. Eastern and southeastern Texas.
3. *B. dealbatus* Say. Alabama to Kentucky, west to Kansas.
4. *B. d. ozarkensis* P. and F. Northern and western borders of the Ozark uplift.
5. *B. d. ragsdalei* Pilsbry. Bluffs of Red river and southwestern Texas.
6. *B. d. pecosensis* P. and F. Southwestern Texas.
7. *B. d. pasonis* Pilsbry. El Paso, western Texas.
8. *B. alternatus mariae* (Albers). Southern Texas.

Of these forms, the anatomy of *B. d. mooreanus*, *B. d. liquabilis*, *B. d. ragsdalei*, *B. d. pecosensis* and the Val Verde county race of *B. alternatus mariae* has been examined more or less fully. All agree in having a rather short, fusiform penis with a basal sheath which in-

⁸ We do not mean to deny that the forms mentioned occur in Texas. The counties along the Rio Grande west of the mouth of the Pecos are still unexplored for shells, and *B. schiedeanus* especially may turn up in this region.

cludes the vas deferens; a rather long and slender epiphallus, and a flagellum. An atrium can scarcely be said to be developed, but the vagina is rather long in all the forms. The globular spermatheca is borne on a long duct, which is lightly bound to the oviduct and is usually somewhat swollen near the middle. The right eye-retractor passes between the ♂ and ♀ branches, and there is an excessively weak and short penial retractor about 1 mm. from the end of the flagellum, and inserted on the lung floor.

B. a. mariæ differs strongly from all forms of *B. dealbatus* by the great length of the penis with its appendages, and of the duct of the spermatheca. Moreover, the penial organs are longer than the spermathecal duct, while in *mooreanus* and *pecosensis* the spermathecal duct is the longer. These differences confirm the opinion, derived

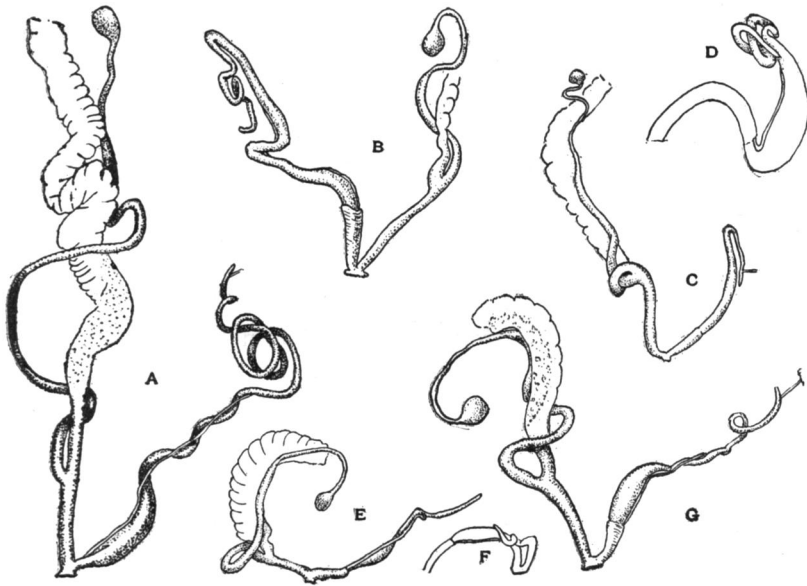


Fig. 5.—A, *Bulimulus a. mariæ*. B, *B. d. liquabilis*. C, *B. d. pecosensis*. D, penis of a fully mature individual of same. E, *B. d. ragsdalei*. F, penis of another individual. G, *B. d. mooreanus*. Fig. D $\times 2\frac{1}{2}$; the other figures $\times 2$.

from a study of the shells, that *B. alternatus* and *dealbatus* are well differentiated specifically.

The measurements of the genitalia in millimeters follows:

*Proceedings of the Academy of Natural Sciences
of Philadelphia, 1906.*

Page 133—Under heading *Length of Spermatheca with duct*, first line of table, change 5 to 50. On last line of table change 1.5 to 15.

	Total length of penis, epiphallus and flagellum.	Length of penis (to insertion of vas deferens).	Length of vagina.	Length of sperma- theca with duct.	Museum number.
<i>B. a. mariæ</i>	58	34	7	5	84,627
Pecos river	45	29			84,635
<i>B. d. liquabilis</i>					
San Marcos	36	29	11	27	91,396
<i>B. d. mooreanus</i>					
Guadalupe river	23	16	6	30	84,628
<i>B. d. ragsdalei</i>					
Devil's river	16	10.5	5	17	84,638
<i>B. d. pecosensis</i>					
	19	11.5	6	20	84,618
	24	1.5			

B. dealbatus mooreanus ('W. G. B.,' Pfr.). Pl. VI, figs. 1-6.

Pfr., Monographia Hel. Viv., VI, p. 143 (1868).

Bulimus schiedeanus in part, W. G. Binney, Terr. Moll., IV, p. 129, pl. 80, fig. 8.

Bulimulus schiedeanus var. *mooreanus* W. G. Binney, Terr. Moll., V, p. 392, figs. 277, 278; Man. Amer. Land Shells, p. 400, figs. 438, 440.

The shell is *thin*, ovate-conic, *opaque white above, coffee-with-cream colored below the periphery*, or sometimes either white or coffee-tinted throughout; sometimes varied with a few gray streaks, or some scattered translucent-gray dots; surface smooth, with the spire more or less striate, apical whorls waxen or dark. Umbilicus narrow. Interior cream-white. Five specimens from New Braunfels measure:

Alt.	26	22.5	25.5	23	22.5 mm.
Diam.	16.5	13.5	14	12	13 "
Aperture	15	12.8	12.6	11.8	12.8 "

Distribution, eastern division of the Lower Sonoran in Texas. Originally described from "Washington and DeWitt counties, Texas." Specimens from both of these are before us, and also from Hays, Comal, Guadalupe, Bexar, Medina, Frio, Uvalde and Victoria counties. Some shells from Fort Worth and Waco, in northern Texas, are also like *mooreanus*, while others resemble *B. d. liquabilis*.

B. d. mooreanus is smaller, thinner and smoother than the Mexican *B. schiedeanus* (Pfr.), but intergrades with *B. d. liquabilis* Rve. through certain specimens having ragged dark streaks, chiefly on the spire, such as fig. 5 of pl. VI. In the main, the subspecies is quite uniform

in characters, and easily recognized. It is the only *Bulimulus* found in the greater part of the region it inhabits, and is one of the commonest forms in collections.

The specimens seen from Fort Worth are not unlike those referred to *B. d. liquabilis* from Waco, and it is not easy to decide upon which race they belong to. They are undifferentiated forms.

In Comal, Guadalupe, Bexar and Medina counties we found only typical *mooreanus*. In Frio county the shells are somewhat more solid and often whiter. In a series of 313 specimens from along the Guadalupe river above New Braunfels (pl. VI, figs. 2, 3, 4) I could find but one shell with any of the ragged stripes of *B. d. liquabilis*. In 165 taken along the river below San Antonio (pl. VI, fig. 1) there were 7 with some ragged stripes, at least on the upper whorls. A series of 55 *mooreanus* from Victoria had 4 striped shells (pl. VI, figs. 5, 6). The percentage of intergrading specimens is therefore small.

B. dealbatus liquabilis (Reeve). Pl. VI, figs. 7-12.

Bulimus liquabilis Reeve, Conch. Icon., V, pl. 57, fig. 387 (Dec., 1848).

Bulimus confinis Reeve, Conch. Icon., V, pl. 86, fig. 643 (Feb., 1850).

Bulimulus schiedeanus Pfr., W. G. Binney, Terr. Moll., V, p. 391, fig. 276, but not the description.

The shell is thin, variable in shape but usually obese, the aperture half the total length or more. Translucent-corneous or brownish-corneous, more or less profusely marked with opaque whitish ragged streaks. Interior whitish or colored like the outside.

This is the form of the humid Austroriparian zone in Texas, as *B. d. mooreanus* is of the arid division. Specimens are before us from the following counties: Dallas, McLennan, Coryell, Bell, Travis, Lee, Hays, Jackson, Nueces. Also from Limestone Gap, Indian Territory.

Where the range of *liquabilis* adjoins that of *mooreanus* there is a belt of overlapping; but so far as we know the two do not actually occur together. At San Marcos, Hays county, for instance, *B. d. liquabilis* lives on the moist low alluvium along the San Marcos river, while *B. d. mooreanus* is found on the Cretaceous limestone hills above the town. It seems that the one form extends finger-like up some of the streams, while the other may occupy intervening upland or calcareous stations.

B. liquabilis and *B. confinis* were both described from "Texas."

B. d. liquabilis differs from *mooreanus* by the predominance of corneous-brown coloring. It is also usually more globose and less smooth. It is more globose than *B. dealbatus*, with less convex whorls, as a general rule, yet there seems to be practically complete intergradation between the races, and some Texas shells are not dis-

tinguishable from those of Alabama, though most others could not be matched from east of the Mississippi. On the whole, the race has intimate relations to those east and west of it, yet seems in its own area to be sufficiently differentiated to be recognized.

Specimens from Jackson county (collected by J. D. Mitchell) are typical of *liquabilis*. They are small (pl. VI, figs. 9, 10, 11), well striped as usual, variable in the length of the spire, and generally have a strong, narrow lip-rib.

Alt.	18.7	20.5	18.5	18	21	mm.
Diam.	12	12.5	11	10	12	"
Aperture	11.5	11.5	10	9.5	11.5	"
Whorls	5½	5¾	6	6	6¾	

Shells from Lee county (J. A. Singley), are larger, more globose, corresponding to Reeve's *B. confinis*. The corneous-brown tint largely predominates over the reduced whitish streaks. Lip-rib present in adults (pl. VI, fig. 12).

Alt.	19	22	25	17.6	mm.
Diam.	14	14	15.2	11.5	"
Aperture	12	13	14.8	10.3	"
Whorls	—	6	6½	6	

Waco specimens mostly have the spire longer, as do those from Belton, Austin and San Marcos. In the series from the latter locality (Ferriss and Pilsbry, 1903) there are about equal numbers of typical striped shells and nearly unicolored corneous-brown ones, with indistinct whitish streaks alternating with pale reddish on the spire (pl. VI, figs. 7, 8). They measure:

Alt.	25.5	25.5	26	mm.
Diam.	14	15	14.5	"
Aperture	14	14	14	"

The genitalia of one of the unicolored shells are figured (fig. B). The individual supplying the preparation was that shown in fig. 7 of plate VI. Fig. 8 of the plate, a streaked shell, was found similar anatomically. Judging by these shells, the race *liquabilis* is quite appreciably different from *mooreanus* in the proportions of the genitalia.

Some specimens from Limestone Gap, Indian Territory, evidently belong to this race.

The shells figured by Binney as *B. schiedeannus* (*Manual of American Land Shells*, p. 399, fig. 437) are apparently *B. d. liquabilis*. They are certainly not the true *schiedeannus*, of which figures may be found in the *Manual of Conchology*.

Bulimulus dealbatus (Say). Pl. VI, fig. 13.

Helix dealbata Say, Journ. Acad. Nat. Sci. Phila., II, p. 159, 1821.

Say gave the localities "Missouri and Alabama." His specimens in the Academy Museum are labelled Alabama. One of these three, agreeing with the dimensions given by him, is figured (pl. VI, fig. 13), as the type of the species. The Alabama form has a *globose last whorl* and rather large umbilicus. The aperture is a little more than half the total length of the shell, but much less than the diameter of the shell. The shell is profusely striped with ragged white stripes on a pale brownish ground. The type measures, alt. 19.4, diam. 12.2, length of aperture 10.6 mm.

The same form occurs in Tennessee, Kentucky (Warren county), and west to Kansas (Shawnee county). Some specimens from the humid portion of Texas also seem to belong here.

B. d. ozarkensis n. subsp. Pl. VI, fig. 14, 15.

B. dealbatus Say, Pilsbry, Proc. A. N. S. Phila., 1903, p. 204 (Seligman, Mo.).

On the northern and western borders of the Ozark uplift this form has been differentiated. The whole shell, and especially the last whorl, is narrower, the aperture is smaller, ordinarily half the total length or less, and the umbilicus is narrower. The shape is about that of *B. d. ragsdalei*, but the last whorl is not rib-striate, though the spire is weakly so. Coloration as in *dealbatus*. Specimens measure:

Locality.	Seligman.	Rogers	Mam. Spring.		
Alt.	26	21.6	21	mm.	
Diam.	13.2	10.5	11	"	
Aperture	12.8	10	10.8	"	
Whorls	7	7	6½		
Limestone Gap, I. T.					
Alt.	22	21	20	20	17 mm.
Diam.	11.3	11.2	9.7	10.8	9.4 "
Aperture	11	10.2	9.5	10.8	9 "
Whorls	6½	6½	6¾	6¾	6

Distribution, northern and western outliers of the Ozark system: Mammoth Spring, Fulton county, Arkansas; Seligman, Barry county, southwestern Missouri (fig. 14); Rogers, Benton county, Arkansas (fig. 15); Limestone Gap, Choctaw Nation, Indian Territory.

While only weakly characterized, this form seems to range over a considerable area, and apparently deserves recognition by name.

B. dealbatus ragsdalei (Pils.). Pl. VI, figs. 16, 17.

Nautilus, III, p. 122; Man. of Conch., XI, p. 129.

The shell varies from the ovate shape of typical *dealbatus* to a more lengthened and slender form, and is *conspicuously rib-striate*, the striae white on a tawny or white-blotched ground and weaker on the base of the shell. The lip-rib is strongly developed. Three adult specimens of the type lot measure:

Alt.	21.5	18.5	16.5 mm.
Diam.	10.8	10.3	8.3 "
Aperture	10	9.3	8 "
Whorls	6½	6½	6

Only dead, more or less bleached shells have been taken from the top of the Red river bluff at the southern end of Warren's Bend, twenty-five miles northwest of Gainesville, Cooke county, and a mile north of St. Jo, Montague county, Texas.

Across the whole State of Texas nearly 400 miles distant, this form reappears on the Rio Grande river, in Val Verde county, in an area inhabited also by *B. alternatus mariaæ*. We are quite unable to find any constant differences between these Southwestern shells and the Red river types, although the apparent absence of the form in the intervening territory suggests that the similar forms of the two areas are independent parallel modifications of *dealbatus* stocks, rather than actually connected genetically. Yet it is quite possible that the widely sundered colonies have been or still are connected through the great conchologically unknown area northwest of the oblique line across the State marking the limit of our explorations. Dead, bleached shells were found in abundance on the high land west of Devil's river, but the living ones for some time eluded us. Finally we found them hidden under the dead reversed leaves which thatch the trunks of Yuccas, and sometimes under prostrate dead Yuccas—retreats they share with the smooth race of *Polygyra texasiana* (pl. VI, figs. 18 to 22). The proportions vary a good deal, a series of adult shells measuring:

Alt.	26.5	20	21	21.5	19	16.5	17 mm.
Diam.	12.5	9.2	10.3	10	10.8	10	8 "
Aperture	12.5	9	10	10.5	10.7	9.3	8 "
Whorls	7½	7	6¾	6½	6	5½	6½

The average size of 78 living shells is about 19 x 9 to 10 mm. Fig. 18 represents the largest shell taken, a dead one 26.5 mm. long. There is but little variation in sculpture among shells from this place.

Along the Rio San Filipe, not far from the Rio Grande, in chaparral on the east side, we found numerous specimens differing from those of Devil's river by having the rib-striæ nearly obsolete on the last whorl except just below the suture. A large number of dead shells were found, but only very few living ones (pl. VI, figs. 23, 24). They have the dull reddish, white-streaked coloration and the shape of the Devil's river *ragsdalei*.

Bulimulus dealbatus pecosensis n. subsp. Pl. VI, figs. 26, 27.

B. d. schiedeanus var., Pilsbry, Man. of Conch., XI, p. 132, pl. 17, fig. 6.

The shell is *conspicuously calcareous*, whitish with some fleshy or sometimes corneous or ochraceous streaks; upper whorls striate, the last somewhat roughened by irregular growth-wrinkles. Spire long, composed of numerous *short* convex whorls, the suture *nearly horizontal*; apex white or pale; aperture small, usually ochre-tinted in the throat, lip strengthened by a rib within.

Alt.	31	29.7	26.5	24	22.8	21 mm.
Diam.	14.8	14	12.8	12	12.7	10.7 "
Aperture	15	14	12.7	10.3	11.5	10 "
Whorls	7½	7½	7½	7½	7	7

Type locality, on the mesa about 1½ miles southeast of the eastern end of the High Bridge of the Pecos (Southern Pacific Railroad), Val Verde county, Texas. We found one small colony of this form, in the midst of the large dark-mouthed *B. alternatus mariæ*, and like that chiefly living on Agave. The extent of the colony was perhaps not more than 50 yards, but as the sun had already set, and we had just emerged from the labyrinthine side canyons of the Pecos, we had time to collect only about thirty-five specimens, each, most of them dead. Everywhere else in the region around the High Bridge we found only *B. a. mariæ*.

This form is clearly a stunted race of the larger and less slender *B. schiedeanus* of the Mexican fauna. *B. schiedeanus* has been considered specifically distinct from *dealbatus* by Binney and all the older authorities, as well as by von Martens, who gives a series of good figures in the *Biologia Centrali Americana*; but while the typical *schiedeanus* is distinct enough, there are not lacking specimens suggesting intergradation with some forms of *dealbatus*. If *schiedeanus*

be retained as a distinct species, then the race *pecosensis* will be relegated to it as a variety.

Some specimens of *pecosensis* taken about thirty years ago by Dr. H. C. Wood, probably, as he informs me, from somewhere in the "Great Bend" of the Rio Grande, were noticed in the *Manual of Conchology*, Vol. XI.

Bulimulus dealbatus pasonis Pils. Pl. VI, fig. 25.

Pilsbry, *Nautilus*, XVI, July 1902, p. 32.

The shell is smaller and more slender than any other form of *dealbatus*, the diameter about half, the aperture less than half the total length of the shell; nearly smooth, being sculptured with irregular growth-wrinkles only. The dead specimens are dull reddish-corneous with some streaks and mottling of opaque white. Whorls $5\frac{3}{4}$ to 6, quite convex. Aperture small, ovate, the insertions of the lip and columella markedly approaching, without an internal lip-rib in the specimens seen. Umbilicus comparatively large.

Alt.	15.7	15.3 mm.
Diam.	7.5	7.8 "
Aperture	6.8	6.7 "

Franklin mountain, near El Paso, Texas. (J. H. Ferriss.)

This is the most distinct, as it is the most remote, of the races of *B. dealbatus*, and unless connecting forms come to light, it may well be given specific rank. The absence of regular striation on the spire, the converging ends of the lip and the diminutive size combine to give it individuality. As yet but few specimens have been found, and in a single place. Some individuals of the Val Verde county *B. d. ragsdalei* approach *pasonis* in size, but in a series of about 200 examined none approach the other characters of the present race.

Bulimulus alternatus mariæ (Albers). Pl. VII.

Die Heliceen, p. 162 (1850).

Binney, Terr. Moll., V, p. 390, figs. 272, 273, pl. li *a*, upper and lower figs.; pl. li *b*, all figs.

This species is recognized by its dense, solid, calcareous texture, oblong shape and colored, usually dark brown or purplish interior, and by the great length of the penis and spermathecal duct. Its range extends in a wide belt along the Rio Grande, from the Gulf at least to the Pecos river. How much farther west we do not know.

B. mariæ was named by Albers for his daughter Mary, having been recognized as distinct on her birthday. The type, figured by Pfeiffer, is a ragged-striped shell with only a low prominence, hardly to be called

a tooth, on the columella. Shells of this exact form and coloring occur at Laredo, Webb county, on the Rio Grande (pl. VII, fig. 28).

In a general way, the eastern (typical) form of *maria* from Frio county and Laredo eastward differs from the western (Val Verde county) form in several respects:

Southeastern Form.

Western Form.

Smaller, more oblong; lip more thickened; columella frequently toothed; often with ragged streaks, at least on the earlier whorls. Pl. VII, lower three lines of figures.	Larger, more conic; lip less thickened within; no columellar tooth; often streaked, but without ragged or mottled streaks. Pl. VII, upper two lines of figures.
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We do not think it advisable at present to make a subspecific separation, especially since none of the names proposed apply to the western race. The genitalia of this race are figured (fig. A).

While almost every colony of the eastern race has slight peculiarities in shape, relative abundance or absence of the several color-forms, etc., yet with large series the intergradation is seen to be so complete that we can find no ground for dividing them into several races, as Prof. Cockerell proposes. His plan (*Journal de Conchyliologie*, 1891, pp. 23, 24) is as follows:

1. With gray or brownish markings:
 - a. Without a columellar tooth, *alternatus* Say.
 - b. Columellar tooth present, *maria* Alb.
2. Without color markings:
 - a. With no columellar tooth, *albidus* Taylor.
 - b. A columellar tooth, . . . *binneyanus* Pfr. MS. W. G. B. [= *intermedius* Singl., Ckll., Corpus Christi.]

The true *B. alternatus* (type in coll. A. N. S.) has not been found north of the Rio Grande, and in all probability does not reach our limits. The name *binneyanus* is preoccupied, so that were the race valid, we should use for that form the name *intermedius* Singley MS. Ckll., based on Corpus Christi shells. The type locality of *albidus* Taylor MS. Ckll. is Derby, Frio county, Texas.

Many perfectly adult Corpus Christi shells have no columellar tooth, and hence we should have to divide them between *intermedius* and *albidus*. Similarly, various specimens selected from the Derby, Frio county, series before me would be either *alternatus*, *albidus* or *intermedius*; while from the Hidalgo series, all four of the supposed varieties

may be selected. The study of good series of shells taken at random and not selected shows that all lots of streaked shells are more or less mingled with white ones, and in colonies of toothed shells, fully adult and old individuals may be found without a tooth. On the other hand there seem, however, to be colonies without ragged-streaked individuals, and also communities in which no toothed shells are to be found.

Perhaps the colonies containing mottle-streaked or toothed individuals are mixed or hybrid communities. It is a case where experiments on Mendelian lines by some one on the ground might be productive of valuable results.

In illustration of the foregoing remarks, a few of the colonies represented in the collection of the Academy may be noticed in more detail. In studying these races it is absolutely essential that the snails be collected alive. The colors, particularly of the interior, are evanescent and fade quickly on exposure to the sun and weather, though they change very little if at all in the museum.

Corpus Christi, Nueces county (pl. VII, figs. 13, 14, 15, 16), collected by J. A. Singley. Of thick-set compact contour, strong, with a thick cream-tinted lip-rib, which is sometimes brown stained. Pinkish white, almost uniform with some very inconspicuous grayish or fleshy streaks. *Not one in a lot of 43 is marked with brown streaks outside.* Interior varying from *pale yellow* to reddish brown, the darker tint exceptional. Columella varying from strongly toothed to nearly straight. Whorls 6, the earliest post-embryonic not distinctly striated. This form is the "*binneyanus* Pfr." of Binney, *intermedius* Singley MSS. of Cockerell.

Alt.	29	27.3	30	25	23	mm.
Diam.	16	14.5	15	14	12	"
Aperture	16.3	14	15.3	14	11.5	"

At Hidalgo, Hidalgo county (pl. VII, figs. 17, 18, 19), the shells are more slender, white, rarely streaked throughout (fig. 17), but almost all of a series of 41 are variegated on the earlier whorls (fig. 18). Some are strongly toothed, but most shells have no columellar tooth. Interior brown.

Alt.	30	29.5	29	28.5	mm.
Diam.	13.5	13.5	13	14	"
Aperture	14	14.5	13.5	14.5	"

A series from Brownsville consists of similar but less elongated shells.

At Derby, Frio county (pl. VII, figs. 20, 21, 22, 23, 24), the shells are bluish white with bluish streaks, a few brown tinted with brown streaks. The columellar tooth is small or wanting. This form has been called *albidus* Taylor, Ckl.

At Laredo, Webb county (pl. VII, lower line of figs.), the shells are large and mostly long. The lot consists of pure white, and of coffee-tinted, brown-streaked shells, with all intermediate forms. A columellar tooth is exceptionally developed.

At Del Rio, Val Verde county (pl. VII, figs. 9, 10, 11, 12), we found a more *conic* race. The shells are *white*, often with some very faint grayish streaks. Interior varying from ochre-yellow to dark brown. In the series of about sixty living shells before us, none has mottled markings, and while in a few there is a weak indication of the columellar tooth, it is as a rule absent. The larger ones measure 29 to 33 mm. long, 16 wide. Some of the dead shells found in the same place are larger, 35 x 18.5 to 37 x 17 mm. A single albino was taken alive (fig. 12). These shells are from the plain along the San Filipe river, on the east side, not far from the Rio Grande. *B. d. ragsdalei* was found in the same place.

On the mesa west of Devil's river we found large dead shells like those from Del Rio but even larger, often with a low lump on the parietal wall, but no tooth on the columella. 39 x 20.5 to 35 x 16 mm.

At the Pecos High Bridge, on agaves, north of the railroad near the eastern end of the bridge, we found *Bulimulus* abundant and finely developed (pl. VII, figs. 1 to 7). The shape varies, but is always more conic than in the eastern localities. It is either nearly uniform white, or coffee-tinted varied with oblique brown or purplish streaks; these two color-forms in about equal numbers, found together on the same plants and connected by intermediate examples. Apex white. The interior is very dark purple-brown. The outer lip is usually but little thickened within, and the columella has no tooth, though often it is slightly salient in the middle. Whorls 7 to 7½.

Alt.	36	37.5	33.3	34.5	36	33.3	37	mm.
Diam.	19	19	17	17	17	16	15	"
Aperture	17.8	17.8	16	16	16	16	14.3	"

The last two measurements show the extremes of shape in a series of 150 living specimens (No. 84,627 A. N. S.).

Another set from east of the Pecos canyon about a mile from the Rio Grande is similar. The largest one measures, alt. 38, diam. 20.3, aperture 19 mm. (pl. VII, fig. 8).

OLEACINIDÆ.

Euglandina singleyana (W. G. Binn.).

Glandina singleyana W. G. B., Fourth Supplement Terr. Moll., V, p. 163 (1891).

Singley, Contrib. Nat. Hist. Texas, p. 302.

Sinking Spring, near San Marcos, Hays county, Texas, young specimens only; New Braunfels, Comal county, and its environs; San Antonio, Bexar county; Hondo river drift, near Hondo, Medina county, and in the canyon of the Pecos at High Bridge, Val Verde county. The last locality is the extreme southwestern point known for the species. Mr. Singley reports it also from Guadalupe, Goliad, Gonzales, Travis, Caldwell and Frio counties.

PUPILLIDÆ.

Pupilla muscorum (L.).

Benson, Arizona.

Pupilla blandi (Morse).

Texas: Flood débris of Guadalupe river, about four miles above New Braunfels, Comal county.

New Mexico: Pecos river drift at Pecos (Ckll.).

The occurrence of this species near New Braunfels is anomalous; that place lies far below its normal zone, and the shortness of the Guadalupe river precludes the idea that it could have drifted any great distance. Mr. Singley also found one specimen at or near the same place.

Pupilla hebes (Anc.).

Proc. A. N. S. Phila., 1900, p. 589, pl. 22, figs. 9, 10.

Huachuca mountains, Cochise county, Arizona. *Two out of about a dozen specimens are sinistral.* They are readily separable from the sinistral *P. syngenes* by the absence of a crest behind the outer lip.

Pupoides marginatus (Say).

In Texas we took this species at San Marcos, Hays county; New Braunfels, Comal county; Hondo river, Medina county, and near the Rio Grande at Del Rio, Devil's river four miles from mouth, and drift of Pecos river near High Bridge, Val Verde county.

Arizona: Drift of San Pedro river at Benson.

Bifidaria pellucida hordeacella (Pils.).

Texas: Drift of Sinking Spring, San Marcos, Hays county; Guadalupe river about four miles above New Braunfels, Comal county; Hondo river, two miles north of Hondo, Medina county; Rio San Filipe near Del Rio, Devil's river near its mouth, and Pecos river near

the High Bridge, all in Val Verde county. Arizona: Benson. New Mexico: Drift of Pecos river at Pecos (Ckll.).

It varies somewhat widely in size, and is found in great quantity in drift débris along all the Texan rivers explored.

Bifidaria pellucida parvidens (Sterki).

Drift débris of Pecos river at Pecos, New Mexico (Ckll.). This subspecies has not before been reported from so far east.

Bifidaria procera (Gld.).

Texas: Drift of Sinking Spring, San Marcos; Hondo river drift, two miles north of Hondo, Medina county.

The var. *cristata* Pils. and Van. was found copiously in the drift of Guadalupe river, Comal county; near Del Rio; Devil's river; and Pecos river near the High Bridge, Val Verde county. Also Benson, Arizona.

Bifidaria contracta (Say).

Texas: San Marcos; Guadalupe river drift, near New Braunfels; Hondo river, near Hondo; Rio San Filipe near Del Rio; Devil's river; Pecos river near High Bridge. Rather abundant in the river débris except on the Pecos, where but three shells were found. In 1885 Pilsbry took specimens at Galveston.

Bifidaria armifera (Say).

Texas: Drift of Guadalupe river four miles above New Braunfels, Comal county; Pecos river near High Bridge. New Mexico: Pecos, on the Pecos river, collected by T. D. A. Cockerell.

Bifidaria pentodon (Say).

Texas: Sinking Spring, San Marcos, Hays county; Hondo river, Medina county.

Vanatta has figured one of the specimens from San Marcos. *Nautilus*, XIX, pl. 6, fig. 11.

Bifidaria tappaniana (C. B. Ad.)

Pupa pentodon of authors, not of Say.

Texas: Guadalupe river about four miles above New Braunfels, Comal county (figured by Vanatta, *Nautilus*, XIX, pl. 6, fig. 12); Hondo river, Medina county; Devil's river, Val Verde county.

Bifidaria perversa Sterki.

Drift débris of the San Pedro river at Benson, Arizona (Ferriss, 1904). Hitherto known from Nogales, Arizona. (E. H. Ashmun.)

Bifidaria ashmuni Sterki.

Huachuca mountains, Cochise county, Arizona (J. H. Ferriss.) Also from the following places, collected by E. H. Ashmun. Arizona:

Near Jerome at Mescal Gulch, Walnut Gulch, Page's ranch, Kirwagen's ranch, and drift of Verde river; Navajo Springs; Santa Rita mountains; Oak Creek at Owensby's; drift of Little Colorado river at Holbrook; Nogales, both north and south of the international boundary. New Mexico: Mountain station, Oscura mountains, Socorro county; San Rafael, Valencia county; White Oaks, Lincoln county.

Subgenus CHÆNAXIS nov.

The shell has a large hollow axis, open below, and about one-third the total diameter of the shell, the structure otherwise being like *Bifidaria s. str.*; peristome continuous and free. Type, *B. tuba*.

The Bolivian *Infundibularia infundibuliformis* (Orb.)⁹ resembles *B. tuba* in having a very large umbilicus, and we at first thought to associate the Arizonian species with it; but *Infundibularia* differs by the strictly conic shell, and in the aperture, which shows but one lamella, a very large angulo-parietal. Other lamellæ or plicæ, if they exist, must be very deeply immersed, as in the group *Immersidens*.

The type of d'Orbigny's species has been lost, and its internal structure is unknown. It was found with *Bifidaria nodosaria* (Orb.), a minute species, imperfectly described and figured, but probably not distinct from *B. pellucida* (Pfr.).

Bifidaria tuba n. sp. Fig. 6.

Shell cylindric with a short apical cone, *openly umbilicate*, the umbilicus nearly one-third the diameter of the shell, penetrating well-like to the apex. Pale brown, smooth, with light growth-lines only. Whorls $5\frac{1}{2}$, convex, the apex obtuse; last three whorls forming the cylindrical part of the shell. The last whorl is compressed around the umbilicus, and scarcely straightened in front. The aperture is short-oval, the peristome continuous, thin and well expanded. The angular and parietal lamellæ are combined into one long lamella, notched on the summit; where the two join, the inner end of the angular projects a little on the right side. The columellar lamella is massive, slightly bifid, deeply placed, and enters about as deeply as the parietal. There are small, short, upper and lower palatal and basal folds, in the typical positions, a short distance within the lip, usually with a minute denticle between them, and another at the base.

Length 3, diam. 1.5 mm.

Drift débris of the San Pedro river, Benson, Cochise county, Arizona. Types No. 87,062 A. N. S. Phila.; cotypes in Ferriss collection. A

⁹*Voyage dans l'Amérique Méridionale*, Mollusques, p. 323, pl. 41 bis, fig. 7-10.

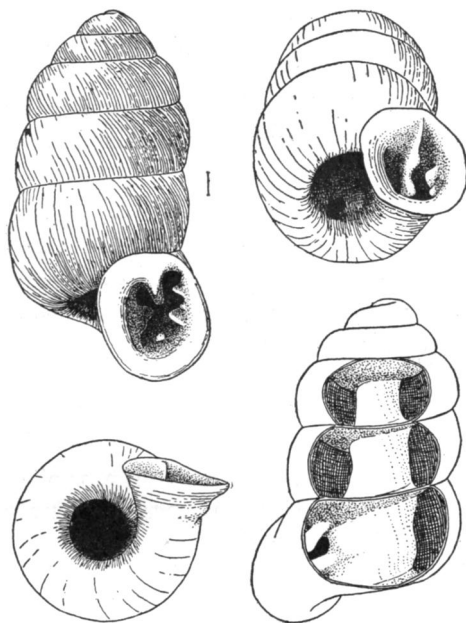


Fig. 6.

single immature specimen was taken by Rev. E. H. Ashmun in drift of the Salt river, at Tempe, Arizona.

Remarkable for its ample umbilicus. The freshest specimens are about the color of *Pupoides marginatus*. None were taken alive. In the adult shell opened (fig. 6) the parietal and columellar lamellæ do not enter deeply, though they go so far that the inner end cannot be seen in the mouth. One broken shell from Tempe, taken by Mr. Ashmun, and which has been in coll. A. N. S. P. for some years, has a strong lamella on the columella, apparently at least a half-whorl long, but not penetrating much farther than fig. 7 shows. This lamella may perhaps be developed during the latter part of the neanic stage, to be resorbed in the fully adult condition. Further material is needed to demonstrate this. It is possible that the Tempe shell represents a distinct species. It tapers slightly more than the types from Benson.

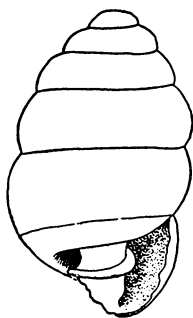


Fig. 7.

Vertigo ovata Say.

Benson, Arizona: Drift of Devil's river, Val Verde county, Texas.

Vertigo binneyana Sterki.

Benson, Arizona (Ferriss).

Vertigo oscariana Sterki.

Drift débris of the Guadalupe river, about four miles above New Braunfels, Texas, a single specimen, a little larger and stronger than Eastern (Austroriparian) examples.

Vertigo milium Gld.

San Marcos, Hays county; Guadalupe river above New Braunfels, Comal county, and on the Hondo river, Medina county, Texas, in flood débris. Only one specimen from each place, among thousands of other *Pupillidae*, etc.

Strobilops labyrinthica texasiana n. subsp.

Shell moderately elevated with dome-shaped spire, brown, whorls $5\frac{1}{2}$, the first $1\frac{1}{2}$ smooth, pale-corneous, the rest regularly ribbed obliquely, the last whorl rounded peripherally or a trifle and obtusely subangular in front, the riblets passing over undiminished upon the base, which is as strongly sculptured as the upper surface (or sometimes smoothish just in front of the aperture). Aperture with expanded, thickened peristome and strong parietal callus, a single strong parietal lamella emerging to the edge of the callus, a second weak one visible within. About half a whorl inward there is a series of about six laminae, the inner one upon the columella, the next short, strong and tongue-shaped, bending outward; the third nearly twice as long, high and sinuous; the fourth very minute and low, often wanting, leaving a space; the fifth and sixth long and low; and just above the periphery on the outer wall a very weak, low, long seventh plica may usually be traced. Umbilicus rather large.

Alt. 1.5, diam. 2.2 mm.

Types No. 91,330 A. N. S. Phila., from drift of the Guadalupe river about four miles above New Braunfels, collected by Pilsbry and Ferriss, 1903. Other localities in Texas are Austin (Pilsbry), San Marcos (Pilsbry and Ferriss), New Braunfels (Ferriss, Pilsbry and Singley), Guadalupe river bottom, Victoria county, and Lavaca river, Jackson county (J. D. Mitchell), Lee county (Singley), Calhoun county (E. W. Hubbard), Gainesville (J. B. Quintard). A smaller form, diam. 2 mm., was taken in drift débris of the Hondo river about two miles north of Hondo, Medina county (Ferriss and Pilsbry). It also ranges northward into Indian Territory and to Kansas.

This form, which for the present we subordinate to the old *S. labyrinthica*, is the only *Strobilops* except *S. hubbardi* which I have seen from Texas. It may be distinguished from *S. virgo* by the costulate base, wider umbilicus and far weaker inner parietal lamella. *S. strebeli* is a much more depressed cone.

The statement by Woodward,¹⁰ copied into American works, that *H. labyrinthica* occurs in pretertiary European strata, is misleading, since the American species is really not identical with any from European strata, though there are numerous allied forms in the European tertiaries. The genus became extinct in Europe, but survives in China, *Helix diodontina* Heude being a *Strobilops*. In America it has not been found in the Northwest or Pacific States, but extends south to Mexico, the West Indies and Venezuela, and a species apparently belonging to the genus has been described from the Galapagos.

VALLONIIDÆ.

Vallonia excentrica Sterki.

Galveston, under boards in a vacant lot. (Pilsbry, December, 1885.)

Vallonia perspectiva Sterki.

Texas: Drift débris of Devil's river, and of Pecos river near the High Bridge, Val Verde county. Arizona: Benson, in drift of San Pedro river.

Vallonia gracilicosta Reinh.

New Mexico: Drift of Pecos river, at Pecos (Cockerell!).

Vallonia cyclophorella Anc.

Arizona: Drift of San Pedro river, Benson, Cochise county, a single specimen.

COCHLICOPIDÆ.

Shell oblong, cylindric-oblong or narrowly tapering, smooth and glossy, with imperforate axis; aperture ovate or acuminate, the columella notched below or continuous with the basal lip. Foot without pedal grooves. Kidney with direct ureter, of the Basommatophorous type. Genitalia with a long appendix on the penis, as in *Achatinella* and the *Pupillidæ*. Jaw and radula about as in *Pupillidæ*.

This group has usually been included in the *Achatinidæ* or *Stenogyridæ*, but the direct ureter removes it to a group of primitive snails represented only by minute species in America, but by the beautiful *Achatinellidæ* and *Partulidæ* in Polynesia. *Cæcilianella* (Cecilioides)

¹⁰ *Manual of the Mollusca*, p. 286, edit. 2, 1868.

belongs to the same family, and probably *Glessula* also, but the pallial organs of that Indian genus are unknown. The group is not related to the *Achatinidæ*.

Cochlicopa lubrica (Müll.).

Bear Park and Cave creek canyon, Chiricahua mountains, and Fort Bowie (Ferriss); Carr canyon, Huachuca mountains (Dr. H. Skinner); all in Cochise county, Arizona. Drift débris of Pecos river, Pecos, New Mexico (Ckll.).

ZONITIDÆ.

Omphalina extends to the western border of the Austroriparian area in Texas. The form taken by us will be discussed in the concluding paper on Southwestern mollusks.

Zonitoides minuscula (Binn.).

Texas: San Marcos, New Braunfels, near Hondo, Del Rio, Devil's river and Pecos river. Everywhere common in drift débris. The specimens all show a tendency to be more widely umbilicate than typical Northern *minuscula*, a large part of them being typical *Z. m. alachuana* (Dall). Those from San Marcos and Comal county are of the size of Northern *minuscula*, but westward the shells reach a decidedly larger size, with the exception of the lot taken at Devil's river, which show but little tendency towards a wide umbilicus.

In Arizona, Ferriss took specimens of var. *alachuana* at Bear Park and Cave creek canyon, Chiricahua mountains, in the drift of San Pedro river at Benson, and in the Huachucas. Like other minutæ, these shells are very rare in the Chiricahua and Huachuca mountains.

Helix mauriniana Orb., from Cuba, which has been put in the synonymy of *minuscula*, seems to be a *Thysanophora* close to or identical with *T. saxicola* (Pfr.), as Arango has already stated. *Z. minuscula* occurs also in Japan.

Zonitoides minuscula neomexicana Pils and Ckll.

This form is distinguished by the possession of minute and shallow spiral striation. It seems to be of somewhat common occurrence in New Mexico, and upon examining a set of seven specimens taken by me in Galveston in 1885 I find that they are similarly sculptured. They came from under boards in a lumber yard, and it may be that they were brought from New Mexico with lumber, though I do not know that any lumber was shipped from New Mexico twenty years ago.

Zonitoides singleyana (Pils.).

Zonites singleyanus Pils., Proc. A. N. S. Phila., 1889, p. 84; 1888, pl. 17, fig. M. (New Braunfels).

Hyalinia laeviuscula Sterki, Nautilus, VI, p. 53, Sept., 1892 (New Braunfels).

Texas: San Marcos, New Braunfels, Del Rio, Devil's river and Pecos river above the High Bridge; everywhere in river débris.

Arizona: Drift of San Pedro river at Benson.

Zonitoides nummus Vanatta.

Proc. A. N. S. Phila., 1899, p. 524, figs. (New Braunfels).

This species seems to be confined to the Texan Lower Sonoran. We took it at San Marcos, Hays county; Guadalupe river above New Braunfels; Hondo river, Medina county; and in Val Verde county near Del Rio; along the Devil's river, and in the Pecos canyon above the High Bridge; everywhere in drift débris.

Zonitoides arborea (Say).

Texas: Galveston; Smithville, Bastrop county; Sinking Spring, near San Marcos, Hays county; near New Braunfels, Comal county.

New Mexico: Drift of Pecos river at Pecos (Cockerell).

Arizona: Cave creek canyon and Bear Park, Chiricahua mountains, Cochise county.

Vitrea indentata (Say).

Drift of Pecos river, Pecos, New Mexico (Ckll.). As usual, it is the Canadian and Carolinian form of the species which extends down the Rocky mountains into New Mexico, and not the Sonoran subspecies.

Vitrea indentata umbilicata ('Singl.,' Ckll.).

Ckll., Nautilus, XII, p. 120, Feb., 1899.

Texas: San Marcos, Hays county; around New Braunfels, Comal county; Hondo river two miles north of Hondo, Medina county; Del Rio, Devil's river and Pecos river at the High Bridge, Val Verde county; Alpine, Brewster county,

Arizona: Cave creek canyon and Bear Park, Chiricahua mountains; Fort Bowie. Also Florida mountains, Grant county, New Mexico. Large specimens of this race are probably what has been reported from Texas as *sculptilis* Bld.,—a species which does not, we believe, occur in that State.

This Sonoran race differs from *indentata* by its distinctly perforate axis and larger average size, yet the perforation varies so much in size in specimens from the Carolinian zone that I would not myself have named the Southwestern form. The name is ill-chosen, since the shells are not "umbilicate," as that term is technically used, but "perforate."

Vitrea hammonis (Ström).

Drift of the Pecos river at Pecos, New Mexico (Cockerell). The specimens scarcely show a trace of spiral lines. The species is unknown in the Austroriparian and Lower Sonoran zones.

Vitrea dalliana roemeri n. subsp. Fig. 8.

Shell openly umbilicate, the width of umbilicus contained about $4\frac{3}{4}$ times in the diameter of the shell, pale whitish-corneous, in general shape resembling *V. dalliana*, *V. wheatleyi* and *V. petrophila*. Sculpture of *very close and regular radial grooves*, on the last whorl of large specimens becoming crowded and less regular, giving a striate appearance. The flat intervals between the grooves show no spiral striae. The base is nearly smooth. Whorls $4\frac{1}{2}$, but slightly convex, slowly widening, the last about double the width of the preceding. Suture scarcely impressed, translucent-margined below. Base convex. Aperture lunate, slightly oblique; the insertions of the peristome are distant.

Alt. 2, diam. 4 mm.; umbilicus .85 mm.; aperture 1.7 x 1.65 mm.

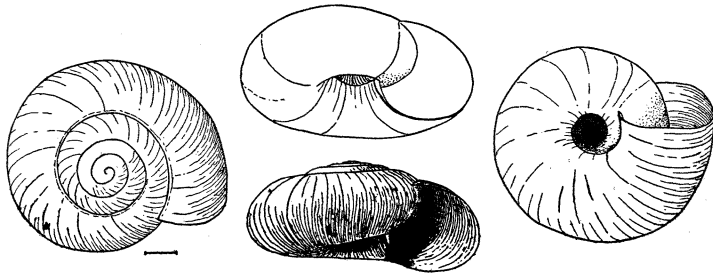


Fig. 8.—*Vitrea dalliana roemeri*.

Sinking Spring creek, near San Marcos, Hays county, Texas. Types No. 91,318, A. N. S. Phila., collected by Pilsbry and Ferriss, 1903. Also taken in several places around New Braunfels, Comal county; in the drift débris of the Hondo river, two miles north of Hondo, Medina county; in drift of the Rio San Felipe near Del Rio, and of the Devil's river, Val Verde county. It has about the distribution of *Holospira goldfussi* and *Helicodiscus eigenmanni*.

This very pretty little species has a slightly more ample umbilicus than *V. wheatleyi* or *petrophila*, and the sculpture is closer and more regular than in either. The last whorl, in dorsal view, is wider than in *V. wheatleyi*. It is much smaller than *V. hammonis*.

V. dalliana roemeri attains a larger size than the Floridian *V. dalliana* and the shells have somewhat more regular and crowded grooves on

the last whorl; it is less depressed, and the aperture is perceptibly less broad, more roundly lunate. The differences seem sufficient to call for subspecific separation. The Texan and Floridian areas of distribution

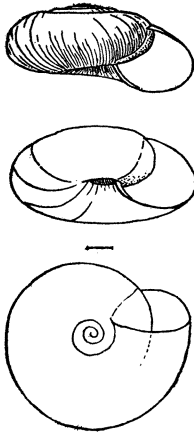


Fig. 9.—*V. dalliana*.

seem to be separated, so far as our present data indicates. *V. dalliana* should be looked for along the northern border of the Gulf. It is known now from peninsular Florida only.

*Vitrea dalliana*¹¹ and *roemeri* are much smaller than *V. hammonis*, and seem to replace that in the Austroriparian and Lower Sonoran zones. When originally described it was compared with *Zonitoides arborea* (Say), but it is not really related to that but to the *hammonis* group. In fact *V. hammonis*, *binneyana* and *dalliana* form a group of very closely related species. In a large number of *V. dalliana* examined from several localities, the largest shell measures, alt. 1.6, diam. 3.2, width of umbilicus .75, aperture 1.4 mm. wide, 1.2 high. This shell, from Osprey, Manatee county, Fla., is here figured.

The figures do not represent the fine and beautiful sculpture of the surface.

Vitrea milium meridionalis n. subsp.

Similar to *V. milium* but larger, diam. about 1.75 mm., with nearly $3\frac{1}{2}$ whorls, the first one finely, *distinctly lirate spirally*, the last whorl with oblique wrinkles much coarser than in *milium*, more or less anastomosing, and fine spiral striæ, the latter distinct on the base.

V. milium with the same number of whorls is smaller and more finely wrinkled, and in Maine and Ohio shells spirals on the first whorl are excessively weak or wanting, not deeply engraved to the tip, as in Texas shells.

Texas: San Marcos, in drift of Sinking creek, in the limestone hills; along the Guadalupe river above New Braunfels (type locality); Hondo river, Medina county; drift of Pecos river. (Pilsbry and Ferriss.)

New Mexico: Cloudcroft, Sacramento mountains (Viereck); Santa Fé (Ashmun).

Arizona: Huachuca mountains (Ferriss); Walnut Gulch near Jerome (Ashmun).

Specimens from Baldwin and Clarke counties, Ala. (C. B. Moore),

¹¹ *Zonites dallianus* Simpson, Pilsbry, Proc. A. N. S. Phila., 1889, p. 83, pl. 3, figs. 9-11.

seem to be referable to this race. In the Northwest another form of the species, *Z. milium pugetensis* Dall, replaces the typical *milium*. Neither of the subspecies differs much from *milium*, but what differentiation there is seems to be correlated with geographic range.

This species was erroneously placed in *Zonitoides* in the Classified Catalogue of 1898. We are now convinced that it belongs, as Morse demonstrated, to the subgenus *Striatura* of *Vitrea*.

***Vitrina alaskana* Dall.**

V. pfeifferi Newc., Proc. Cal. Acad., II, p. 92, 1861; not of Deshayes, 1852.

Vitrina alaskana Dall, Land and Fresh-Water Mollusca of Alaska and Adjoining Regions, Harriman Alaska Exped., XIII, p. 37.

Arizona: Huachuca mountains (Ferriss), numerous rather small specimens, the only ones we have seen from Arizona. It seems to be a common species of the Canadian and Transition zones eastward, specimens being before us from the following places in New Mexico: Chiricahua canyon near Raton (Cockerell); Las Huastus canyon, Sandia mountains, near Albuquerque (Miss Maud Ellis); near Las Vegas (Miss Mary Cooper); White Oaks and Gilmore's Ranch, Sierra Blanca (Ashmun); Fort Wingate (Dr. E. Palmer); James canyon, Cloudcroft, Sacramento mountains (H. L. Viereck).

The type locality of *V. alaskana* is Carson valley, Nevada; but it has a wide range, from Alaska to the Mexican boundary and probably beyond, southward occurring only at high elevations.

***Euconulus fulvus* (Müll.).**

Drift of Pecos river, Pecos, New Mexico (Cockerell). Cave creek canyon, Cochise county, Arizona (Ferriss).

***Euconulus chersinus trochulus* (Reinh.).**

Nautilus, XII, p. 116.

Texas: Sinking Spring, San Marcos, Hays county; New Braunfels and vicinity, Comal county; Hondo river, north of Hondo, Medina county; Rio San Felipe near Del Rio, and Devil's river, Val Verde county; everywhere in drift debris.

ENDODONTIDÆ.

***Pyramidula cronkhitei anthonyi* Pilsbry, n. n.**

Helix striatella Anthony, Boston Journ. of Nat. Hist., III, p. 278, pl. 3, fig. 2' 1840. Not *Helix striatella* Rang, 1831.

This shell, well known under the preoccupied name *H. striatella* Anth., has typically a rounded periphery and moderately developed oblique and sigmoid rib-striae, 4 or 5 in the space of a mm. on the front of the last whorl at the periphery. There are $3\frac{1}{2}$ to $3\frac{3}{4}$ whorls.

Alt. 2.7, diam. 5.25 mm. Type locality, Fairmount Park, Philadelphia, near "Strawberry Mansion," No. 68,899, A. N. S. P., collected by E. G. Vanatta.

In my opinion the widespread Eastern race is not specifically distinct from *Helix cronkhitei* Newc., of northern California, etc., of which specimens from Dr. Newcomb are before me, but it evidently requires separation as a subspecies.

Arizona: Chiricahua mountains, Cochise county, at Fort Bowie, Bear Park and Cave creek canyon (Ferriss); Carr canyon, Huachuca mountains (H. Skinner).

New Mexico: Drift of Pecos river at Pecos (Ckl.).

Texas: In 1885 I dug a single specimen of this species from the bank of Comal creek, New Braunfels, where it occurred with several other land and fresh-water shells. Singley reports it from the Pleistocene of Swisher county. It is not known to occur living in Texas, or anywhere in the Austroriparian zone. Its occurrence in the Texan Pleistocene is anomalous, like the presence of *Pupilla blandi* at New Braunfels.

RADIODISCUS Pilsbry, n. gen.

Minute, discoidal, openly umbilicate Patuloid snails with *the first* $1\frac{1}{2}$ *whorls minutely engraved spirally*, the rest of the shell densely *radially costulate*; aperture lunate, but slightly oblique and as high as wide. Type, *R. millecostatus*.

This genus is proposed for a group of tiny Pyramidula-like snails, various members of which have been found in Arizona, Mexico and South America as far south as Patagonia. In the spiral sculpture of the embryonic whorls these shells are like *Helicodiscus*; in shape and size they resemble *Planogyra*, but in that the embryonic shell is smooth. There are also some similar Polynesian forms, referred to *Charopa*, etc.

In the *Endodontidae*, where small differences in the shell characterize extensive series of species, it seems desirable to recognize as of generic value such readily recognizable groups as *Radiodiscus*. The species are chiefly distinguished by their dimensions and the degree of fineness of the sculpture. There are several undescribed forms in the collection of the Academy.

Radiodiscus millecostatus n. sp. Fig. 10.

Shell very small, disk-shaped, chestnut-brown, the first whorl bluish-white. Whorls $3\frac{3}{4}$, slowly widening, separated by a very deep, channelled suture. The first whorl projects a little, and is microscopically striate spirally, the rest of the whorls are radially very densely costulate, the riblets nearly straight, delicate and much narrower than

their intervals, and about 21 in number in a millimeter measured at the periphery, in the front of the last whorl. The last whorl is rounded throughout. The umbilicus is widely open, its width contained about three times in the diameter of the shell. The aperture is slightly oblique and deeply lunate. Alt. 1.1, diam. 2 mm.; diam. of umbilicus .6 to .7 mm.

Huachuca mountains, Cochise county, Arizona, (J. H. Ferriss); Carr canyon (Dr. Henry Skinner). Also in the State of Michoacan, Mexico, at Patzcuaro and Morelia (S. N. Rhoads, 1899).

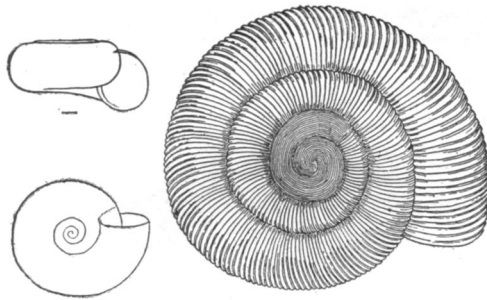


Fig. 10.

This tiny Patuloid, of a group new to our fauna, is one of the most interesting recent finds. It is related to *R. hermanni* (*Helix hermanni* Pfr.), of central and eastern Mexico, but that species is larger and more coarsely sculptured. The two species occur together at the Mexican localities mentioned above, but are readily separable. Dr. Henry Skinner found one broken specimen of *R. millecostatus* in Carr canyon, Huachucas.

Genus **HELICODISCUS** Morse.

This genus has hitherto been considered to include two species, *lineatus* (Say) and *fimbriatus* Wetherby. The accessions of Southwestern material show that several other forms must be recognized. The species are not very conspicuously differentiated, and young shells by themselves are not always readily placed; yet with adults we find no difficulty. The salient characters of the forms follow:

- a*.—Diam. of shell 3 to 3.5 mm., whorls 4 to $4\frac{1}{2}$; teeth almost always present. Eastern United States, . . . *H. parallelus* (Say).
- a*¹.—Diam. of shell 4.5 to 5 mm., whorls $4\frac{1}{2}$ to $5\frac{1}{2}$; often deficient in teeth.
- b*.—Spiral striæ obsolete. Idaho. . . *H. salmonensis* (Hemph.).

*b*¹.—Spiral striæ well developed, subequal; last whorl not deflexed at aperture.

c.—Umbilicus very wide; last whorl narrow, aperture very small. Arizona and New Mexico,

H. e. arizonensis n. subsp.

*c*¹.—Umbilicus smaller, more cup-shaped, last whorl wider. Texas, *H. eigenmanni* Pils.

*b*².—Spirals coarse, some of them more conspicuous, with a cuticular fringe; last whorl in fully adult shells abruptly deflexed in front. East Tennessee, North Georgia, *H. fimbriatus* Weth.

Helicodiscus parallelus (Say). Pl. VIII, figs. 7, 8, 9, 10.

Helix lineata Say, Journ. Acad. Nat. Sci. Phila., I, p. 18 (1817); II, p. 373.

Not *Helix lineata* Olivi, Zool. Adriatico, p. 177 (1792).

Planorbis arallelus Say, Journ. A. N. S. Phila., II, p. 164, (1821), corrected to *parallelus* in the Index, p. 407. (Upper Missouri.)

Helicodiscus lineatus Morse, Journ. Portland Soc., I, p. 25, figs. 61, 62, pl. 2, fig. 3; pl. 7, fig. 63 (1864). Binney, Man. Amer. Land Shells, p. 75.

This common species has been well described by Binney and others. It has ordinarily four whorls, but there may be as many as 4½ in exceptionally large shells. At least one pair of tubercular teeth may be seen in most specimens. Shells of maximum size measure:

Alt. 1.3, diam. 3.5 mm. (Grand Rapids, Mich.)

Alt. 1.25, diam. 3 mm. (Philadelphia.)

The typical form of *H. parallelus* is before me from localities in Ontario, Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, Ohio, Michigan, Minnesota, Indiana, Iowa, Kentucky, Tennessee, Alabama, Florida, Missouri, Kansas, Arkansas, Indian Territory.

I have not seen Texan specimens of typical *lineatus*, but it doubtless occurs in northern and eastern parts of the State.

In New Mexico, at Pecos, Las Vegas, Mesilla, Sandia mountains and other places, and in the Pecos river canyon near its mouth, Val Verde county, Texas, there is a form of *H. parallelus* with rather weak, sparse spirals, the intervals more distinctly striate radially than in typical *parallelus*. This seems to be a form of the southeastern Rocky mountains and southward to the Rio Grande, occupying territory between the ranges of *H. eigenmanni* and *H. arizonensis*, with some overlapping on the territory of the latter.

Say's first name, *Helix lineata*, was preoccupied, but his *Planorbis parallelus* applies to the same species. In the text of the *Journal* the first letter of the name did not print up, but the space in place of it shows that it had been there, and the *p* is correctly supplied in the index. The type used in that volume of the *Journal* was old and full

of "bad letters." All authorities agree that such obvious typographical errors should be corrected.

Helicodiscus eigenmanni Pils. Pl. VIII, figs 1, 2, 3.

Nautilus, XIV, p. 41. August, 1900 (Beaver cave, near San Marcos, Texas).

This fine species is easily recognized by its large size, the shell in all stages of growth being very much more robust than *H. parallelus*. It is sculptured with numerous spiral threads as in *H. parallelus*, and when fresh is pale yellow. Alt. 2, diam. 5 mm., with $5\frac{1}{2}$ whorls.

We took specimens in the drift débris of Sinking creek at San Marcos, Hays county; on the Guadalupe river above New Braunfels, Comal county; on the Hondo river, Medina county, and in the drift of Devil's river, Val Verde county; Alpine, Brewster county. I have seen specimens also from Calhoun county (Hubbard), Lee county (Singley), and Navidad river bottom, Jackson county (J. D. Mitchell). It has not been reported from any place out of Texas, and seems to have about the same distribution as *Holospira goldfussi*.

Helicodiscus eigenmanni arizonensis n. subsp. Pl. VIII, figs. 4, 5, 6.

Shell larger than *H. parallelus* with $4\frac{1}{2}$ to nearly $5\frac{1}{2}$ whorls, the spire flat or convex, the umbilicus wider than in *parallelus* or *eigenmanni*. Surface closely and strongly lirulate spirally. Aperture oblique, lunate, very small.

Alt. 2, diam. 5 mm., whorls $5\frac{1}{2}$. (Fort Bowie.)

Alt. 1.5, diam. 4.6 mm., whorls $4\frac{1}{2}$. (Cave creek canyon.)

Arizona: Fort Bowie (type locality); Bear Park and Cave creek canyon, Chiricahua mountains; Huachuca mountains (Ferriss); Santa Rita mountains (Ashmun). New Mexico: Florida mountains, Grant county (Ferriss); Bland, Sandoval county (Ashmun); débris of Arroyo Pecos at Las Vegas (Ckll.).

Readily distinguished from *H. parallelus* when mature by the greater size, with wider umbilicus, more whorls and proportionately smaller mouth. Some specimens are two-toothed. *H. eigenmanni* has a smaller umbilicus, whorls of markedly greater calibre and a larger aperture.

Helicodiscus salmonensis (Hemphill).

Helicodiscus fimbriatus Wetherby (*salmonacca* Hemphill), W. G. Binney, Third Supplement to Terr. Moll., V, Bull. Mus. Comp. Zool., XIX, No. 4, p. 189 (May, 1890).

Helicodiscus fimbriatus var. *salmonensis* Hemphill, in Binney, t. c., p. 220 (May, 1890).

Helicodiscus fimbriatus Wetherby, var. *salmonaceus* Hemphill, Binney, Fourth Supplement, Bull. Mus. Comp. Zool., XXII, No. 4, p. 177, pl. 3, fig. 8.

Distinguished by the absence of spiral striæ, according to Hemphill.

I have not seen specimens. Mr. Binney in his first note considers the Salmon river form identical with what Mr. Simpson reported as *H. fimbriatus* from Indian Territory, and gives no separate or definite description of it, though he mentions that Hemphill had given the (MSS.) name "*salmonacea*." The figure of one of the original specimens, given in Binney's Fourth Supplement, represents a shell with wide umbilicus and small aperture, like *H. arizonensis*, from which it differs, according to published information, by the smoother surface, *arizonensis* being constantly very well sculptured.

Punctum pygmæum (Drap.).

San Marcos, Hays county; Comal county; Hondo river, Medina county; Devil's river, Val Verde county.

The form in this region is slightly larger than northeastern specimens, and is more strongly sculptured. There are barely four whorls, the first $1\frac{1}{2}$ smooth, the next striate; the last two whorls have striæ at regular intervals much larger, with about six fine striæ in each space, and the basal spirals are very distinct. This sculpture reminds one of the west coast forms, *conspicuum*, *pasadenæ* and *californicum*, which however are decidedly larger and coarser shells of a dark brown color.

SUCCINEIDÆ.

Succinea luteola Gld.

Gould, Proc. Bost. Soc. N. H., III, p. 37, June, 1848 (Texas); Terr. Moll., II, p. 75, pl. 67c, fig. 1. (Florida; Texas, especially Galveston.)—Binney, Terr. Moll., V, p. 419; Man. Amer. Land Shells, p. 441.

Succinea texasiana Pfr., Monogr., II, 526; Roemer's Texas, p. 456, 1849 (Galveston).

Succinea lutescens Sowerby, Conchologia Iconica, XVIII, pl. 10, fig. 67 *a, b*, 1872 (Texas).

We took specimens in Texas along the Guadalupe river above New Braunfels, Comal county; San Antonio, Bexar county; near Hondo river about two miles north of Hondo, Medina county, and in Val Verde county at Del Rio, high land west of Devil's river, and in the canyon of the Pecos near the High Bridge.

In Gould's original description the only locality given was Texas. In the *Terrestrial Mollusks* he states "found in Florida, and more abundantly in Texas, especially in the region of Galveston." Specimens collected at Galveston by the author in 1885 agree perfectly with Gould's figures, and that place may be taken to be the type locality. I have seen no Florida shells which I would refer with certainty to *luteola*, though *S. floridana* is closely related.

Succinea concordialis Gld. Figs. 11, 12.

Gould, in Terr. Moll. U. S., II, p. 82 (Lake Concordia).—Binney, Terr. Moll. U. S., V, p. 419; Man. Amer. Land Shells, p. 441.
Succinea forsheyi Lea, Proc. A. N. S. Phila., 1864, p. 109; Obs. Gen. Unio XI, 134 (Rutersville, Texas).
Succinea haleana Lea, Proc. A. N. S. Phila., 1864, p. 109 (Alexandria, La.).
Succinea halei Lea, Obs., XI, 136 (*n. n.* for *S. haleana*).

Distribution, Gulf States from Florida to the Rio Grande, on mud or herbage near the water's edge. Common from Louisiana westward, probably rare and local eastward.

The type locality, Lake Concordia, is not in Texas, as Gould and Binney supposed, but in Louisiana. The lake is an abandoned oxbow of the Mississippi river, opposite Naches, Mississippi. Some of Lea's original lot of *S. halei* (*haleana*) before me show that to be merely the young of *concordialis*. *S. forsheyi* Lea, of which two cotypes are in the Philadelphia collection, is surely identical with *concordialis*.

An adequate knowledge of the distribution of *S. concordialis* eastward awaits further exploration of the Gulf coastal peneplain, which in Mississippi, Alabama, Georgia and Florida has been very imperfectly examined for land mollusks. I have not seen *S. wilsoni* Lea, described from Darien, Ga., the figure of which looks a good deal like *concordialis*, though it seems to be less swollen basally. Specimens collected by Mr. A. A. Hinkley at Cypress creek, Ala., in 1895 are evidently *concordialis*; and a set of very pale shells, corneous instead of amber-colored, before me from Mayport, Florida, collected by M. A. Mitchell about twenty years ago, seems to agree with *concordialis* in everything but color. Northward it extends to Frierson (L. S. Frierson) and Bayou Pierre (George Williamson), in northwestern Louisiana, the specimens from these places being rather small. The species must also extend in a long lobe up the Mississippi and its tributaries, for typical specimens have lately been sent by Mr. A. A. Hinkley from Dubois, Illinois, and by Mr. T. Van Hyning from Des Moines, Iowa. Mr. Van Hyning notes that "the animal is black with small yellow dots." These Northern shells may be distinguished from *S. retusa* by their pot-bellied figure and reddish apex.

In Texas, specimens were taken by us in April at San Marcos, Hays county; New Braunfels, Comal county; San Antonio, Bexar county; along the Rio Grande near and San Felipe river, at Del Rio, and along the Devil's river, Val Verde county. We have seen it also from Lee county (Singley) and Spring creek, Victoria county (J. D. Mitchell).

It lives on the moist earth immediately adjacent to the water's edge, and where found is usually abundant. It is a thin shell, rather

deeply amber-colored, with the apical whorls darker, reddish-orange. Whorls $3\frac{1}{2}$, the last deeply descending, somewhat flattened above, *very convex basally*, having thus a more sack-like contour than *S. retusa*; this being its chief peculiarity. The sculpture consists of rather coarse wrinkles and often some indistinct spiral impressions on the last whorl. The aperture is symmetrically ovate, the columella concave throughout, with a delicate fold above. Large specimens from San Marcos measure:

Length 16.8, diam. 9, length of aperture 11.5, width 6.7 mm.

Length 16, diam. 8, length of aperture 10.5, width 6 mm.

The mantle is intensely black, dappled throughout in the last whorl with rounded yellowish spots. Those above the kidney are brighter, more conspicuous and usually larger, often more or less confluent.

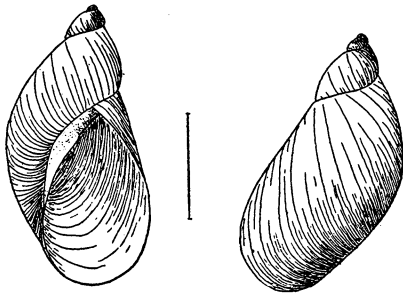


Fig. 11.



Fig. 12.

Towards the edge of the mantle the spots are large and lengthened. The foot including head and eye-stalks is pale grayish-white, speckled with irregular grayish-black spots. The sole is pale yellow. Figs. 11 and 12 were drawn from specimens taken at San Marcos, Texas, near the river.

Specimens from the Rio Grande and Devil's river are of almost as large size; but in some situations it is much smaller, a set from along the San Filipe river at Del Rio measuring, length 12, diam. 6.7, length of aperture 8 mm. Those taken at San Antonio and New Braunfels are also of small size. Such variation in size is apparently not racial, but dependent upon local conditions of the food supply, etc. The color and markings of the mantle are substantially the same in all colonies we found, though there is individual variation in the size of the light spots, figure 12 representing one of the darker individuals.

Succinea grosvenori Lea.

Proc. A. N. S. Phila., 1864, p. 109 (Santa Rita Valley, Kansas?, and Alexandria, Louisiana); Obs. Gen. Unio, etc., XI, p. 135, pl. 24, fig. 108.

S. mooresiana Lea, Proc. A. N. S. Phila., 1864, p. 109 (Court House Rock, Platte river, on the California route); Obs., XI, p. 136, pl. 24, fig. 109.

S. lineata W. G. Binney, Proc. A. N. S. Phila., 1857, p. 19; Man. Amer. Land Shells, p. 174.

This species is characterized by its very full, rounded whorls and irregular sculpture, often with traces of spiral lines, though as frequently without them. Having part of the original specimens of the above synonyms before us, we are convinced that the three supposed species cannot be separated, although one would hardly expect the same form to range from the lower Mississippi to and throughout the arid great plains and the mountain region of Colorado and New Mexico.

Succinea greerii Tryon, described from Vicksburg, Mississippi, is a little less swollen, with the suture not quite so deep, but it is doubtful whether the slight differences shown by the lot of eight specimens will prove constant.

The species belongs to the *campestris* group.

We took a few specimens of *S. grosvenori* at San Antonio, Texas, with *S. concordialis* and a large form of *S. avara*.

Succinea avara Say.

Texas: San Marcos, Hays county; Comal county; San Antonio, Bexar county; Devil's river, Val Verde county. Arizona: Benson, Cochise county.

AURICULIDÆ.**Caryohium exile** H. C. Lea.

San Marcos, Hays county; New Braunfels, Comal county; Hondo river, Medina county, and Devil's river, Val Verde county, Texas. Common in drift débris.

Carychium exiguum (Say).

Drift of Hondo river, Medina county; of Devil's river, Val Verde county, and of Guadalupe river, Comal county, Texas.

LYMNÆIDÆ.**Lymnæa columella** Say.

New Braunfels, Comal county, Texas. A single slender specimen.

Lymnæa desidiosa Say.

Texas: San Marcos, Hays county; New Braunfels, Comal county; San Antonio, Bexar county; Rio San Filipe, Val Verde county.

Lymnæa humilis Say.!

Guadalupe river, Comal county, Texas.

Lymnaea bulimoides cockerelli n. subsp. Figs. 13-17.

Shell subglobose, pale yellowish-corneous, composed of $4\frac{1}{2}$ convex whorls which are finely striate but without spiral lines or malleation. *Spire very short*, last whorl and aperture very large. Aperture short-ovate, its length three-fifths to two-thirds that of the shell. Columella broadly expanded, not folded. Umbilicus large.



Fig. 13.

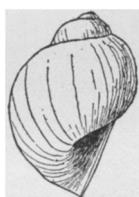


Fig. 14.



Fig. 15.



Fig. 16.



Fig. 17.

	Las Vegas, N. M.			Arroyo Pecos.			Ogalalla, Neb.		
Alt.	10	8.3	8	8.7	8.5	12	8	9	mm.
Diam.	7.2	6	6.2	6	6	7.8	6	6.6	"
Aperture	6.7	5.3	6	5.7	5	7.5	5.8	6.1	"

New Mexico: Las Vegas (type locality, Miss Mary Cooper), and in the charcoal zone of the Pleistocene of Arroyo Pecos (T. D. A. Cockerell); near Farmington (George H. Pepper); Acama (Dr. E. Palmer). Colorado: Pool southeast of Denver (J. D. Putnam). Nebraska: Ogalalla (C. T. Simpson). Dakota: Lake Hermann (P. C. Truman).



Fig. 18.



Fig. 19.

This form differs from *L. bulimoides* and *L. techella* by its more globose shape and shorter spire, and so far as we have seen is readily separable from both. Figs. 13-15 represent the types from Las Vegas; 16, 17 are larger shells from Farmington, sent by Mr. George H. Clapp.

L. bulimoides sonomaensis Hemphill, from Sonoma county, California, approaches *cockerelli*, but differs by the more rapidly expanding last

whorl, narrower flat columella and *narrower umbilicus*, which is like that of typical *bulimoides*. A specimen measures, alt. 10, diam. 7.7, aperture 7.2 mm. (figs. 18, 19).

Lymnaea bulimoides techella (Hald.). Figs. 20-23.

Limnaea techella Hald., Amer. Journ. of Conch., III, p. 194, pl. 6, fig. 4. (Texas.)

Shell obese, with *acutely conic spire*, of five or six convex whorls; pale yellowish or light brown, finely striate and *usually malleate*, the flattened facets obliquely descending. Last whorl very ventricose, umbilicus large. Aperture short-ovate, about three-fifths the total length; basal lip expanded, *columellar lip broadly dilated*, without a fold. Umbilicus large.

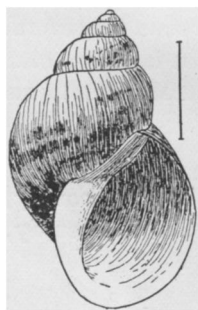


Fig. 20.



Fig. 21.



Fig. 22.



Fig. 23.

	Cotype.	San Marcos, Texas.					Tempe, Ariz.	
Length	8	8.5	11.8	13	14	12.7	12.5	mm.
Diam.	5.1	5.1	7.3	7.6	9	7.8	7	"
Aperture	4.9	5.1	7.3	6.7	8.8	7	6.8	"

In the area under consideration we have seen specimens from the following places:

Texas: Fort Worth (Sampson); Royse, Rockwall county (Ragsdale); Dallas (E. Hall); Houston (Pilsbry); San Marcos, Hays county (Pilsbry and Ferriss); mouth of Nueces river (Singley).

New Mexico: Albuquerque, and McCarty, Valencia county (Ashmun); Rio Grande at Mesilla (Cockerell).

Arizona: Salt river at Tempe (Ashmun).

Other records could probably be supplied from the literature, but it seems usually to have been referred to as *L. bulimoides*. Figs. 20-22 represent specimens from San Marcos, Hays county, Texas; fig. 23 is a more malleate shell from Salt river, Tempe, Arizona.

The young of one season have a comparatively shorter spire than old shells, the rate of descent of the suture progressively increasing somewhat. As usual, there are only traces of malleation at this stage. The erosion of the apices in all but one of the type lot (as mentioned by Haldeman) makes them shorter than they would otherwise be, giving much the appearance of *L. b. cockerelli*. Abundant series from Houston and San Marcos collected by Pilsbry, with others from various naturalists, demonstrate the identity of Haldeman's shells with the larger-spired adult form figured above. *L. techella* was formerly considered by one of us to be a synonym or race of *L. cubensis* Pfr., and *L. bulimoides* was treated as a variety of the same species. They are certainly very similar, but *cubensis* has a more triangular and less broadly developed columellar expansion; and in view of the way *Lymnaea* is being split up into species and races, it may be best to retain the several forms as distinct species or races until the subject can be taken up with ample material and time for the study of Antillean and Mexican forms together with our own.

***Planorbis trivolvis* Say.**

Specimens referable to typical *P. trivolvis* were taken in Comal county, and at Del Rio, Devil's river and the Pecos river, Val Verde county, Texas.

***Planorbis bicarinatus* Say.**

Guadalupe river, Comal county, Texas; abundant and typical.

***Planorbis carus* n. sp. Pl. IX, figs. 4, 5.**

Shell discoidal, biconcave, the spiral on the left side slightly more sunken and narrower than on the right. Whorls $3\frac{1}{2}$, convex, the last round peripherally and on both sides, curving more abruptly into the concavity on the left side. Sculpture of *close, very regular obliquely radial rounded striae* separated by slightly narrower deep grooves. Pale brown in color. Aperture but slightly oblique, heart-shaped, peristome thin, acute, a trifle dilated at its insertions. Diam. 3.3, alt. (thickness) 1 mm.

"Sinking Spring" near San Marcos, Hays county, Texas; Guadalupe river about four miles above New Braunfels, Comal county. Rio San Filipe and Devil's river, and canyon of the Pecos river about a mile above the High Bridge, Val Verde county; everywhere in drift debris. Types from the last locality.

This little *Planorbis* is very distinct by its beautiful sculpture, constant in numerous specimens from five rivers in central and western Texas. It is much more abundant in the Rio Grande drainage than

in Hays and Comal counties. It is about the size of *P. parvus*, but the aperture is less oblique and the sculpture differs. It was found with *parvus* in Comal county and in the Pecos canyon.

Planorbis filocinctus n. sp. Pl. IX, figs. 1, 2, 3.

Shell very small, biconcave, the spiral narrower and more deeply sunken on the left than on the right side. Whorls about $2\frac{3}{4}$, the last broadly rounded peripherally, rounded also on both sides, but less convex on the right than on the left side. Sculpture of inconspicuous growth-lines and numerous *thread-like spiral striæ*. Color of bleached specimens white or faintly yellowish. Aperture oblique, heart-shaped, about as long as wide, excised moderately by the preceding whorl.

Greatest diam. of the disk 2.4, alt. (thickness) nearly 1 mm.

San Pedro river, Benson, Arizona, in drift débris. Types collected by J. H. Ferriss, 1904.

This little species may be at once recognized by its spiral striation, which is far stronger than in any other North American species. It is flattened less than *P. parvus*. Only five specimens were taken, but it is so unlike other known Mexican or United States Planorbes that there seems no doubt of its specific distinctness.

Planorbis parvus Say.

Guadalupe river about four miles above New Braunfels, Comal county; Devil's river, Val Verde county, Texas. San Pedro river, Benson, Arizona.

Planorbis cultratus Orb.

Pilsbry, Nautilus, III, p. 63, pl. 1, figs. 1, 2, 3.

This species is thin and delicate, very acutely carinate at the periphery which is close to the left side. In 1889 one of us reported it from Hidalgo, Texas, where it was taken by Mr. Singley. In 1903 we took a single young shell in the drift débris of Devil's river, Val Verde county. The young have a much less acute keel, in fact are angular rather than carinate, and they are less compressed in proportion. *P. cultratus* is found also in Florida (collected at Miami by S. N. Rhoads), Central America and the West Indies. Few of the specimens thus far known from Texas are fully mature or in good condition.

Planorbis liebmanni Dkr.

Canal at New Orleans, Louisiana (H. Hemphill!). In Texas at Waco (Hemphill), Austin (E. Hall), San Marcos, New Braunfels, Hondo river, Del Rio, Devil's river and Pecos river (Ferriss and Pilsbry); also in the southeastern part of the state in Victoria county (J. D. Mitchell) and near Brownsville, Cameron county (Clapp). Also in Mexico.

Well-grown specimens have a diameter of 9 to 10 mm., with about 5 whorls.

***Segmentina obstructa* (Morel.).**

Except for the teeth, this species is not distinguishable from *Planorbis liebmanni* Dkr. It does not, however, attain quite so large a size, the largest we have seen measuring slightly less than 9 mm. diameter. The teeth are found in very young shells also; but never more than one set is present at any stage of growth, so far as seen. Specimens are before us from the following places, all in Texas:

Austin (E. Hall); San Marcos, Hays county; New Braunfels, Comal county; Hondo river north of Hondo, Medina county (Pilsbry and Ferriss); Brownsville, Cameron county (sent by G. H. Clapp); Hidalgo, Hidalgo county (Singley); Rio San Filipe, Devil's river and Pecos river, Val Verde county (Ferriss and Pilsbry).

It has also a wide range in Mexico.

The genus *Segmentina* was based upon the European species *S. nitida* Müll. This is a very glossy, flattened shell with acutely angular periphery, simple thin lip, deeply embracing whorls, and barriers composed of three laminae (parietal, basal and upper) transverse to the whorl, leaving a narrow, three-branched space between them.

In eastern Asia a modification of this type is found in such species as *S. largillierti* (Phil.), forming the subgenus *Polypylis* Pils. The shell is less compressed and not carinate, but glossy with deeply clasping whorls. The parietal lamina is obliquely transverse, the others transverse, basal long, a shorter one in the outer wall, and one or two in the upper margin. There are several or many barriers.

The American forms, subgenus *Planorbula* Hald., have less smooth and much less compressed shells, the whorls only slightly clasping, often angular or subangular on the right side but rounded peripherally. There are six laminae: a sigmoid, obliquely entering parietal with a small tubercular denticle near its lower or left end; a transverse basal; an obliquely entering outer lamina with a transverse one above it, and a small entering lamina in the upper margin.

In *S. armigera* the entering lamella in the outer margin curves upward slightly at its inner end. In *S. wheatleyi* all of the laminae are much more strongly developed, and the entering outer one is much longer, running up in a long curve behind the transverse lamina above it. The structures are, however, fundamentally identical in the two species.

In the Antillean and Mexican group to which *S. obstructa* belongs

the whorls are rounded, the parietal laminae are as in *Planorbula* except that the larger one stands more obliquely, the basal lamina is transverse, but *all the rest on the outer wall are entering plicae*, the larger lower one curving downward a little at its inner end, not upward as in *armigera* and *wheatleyi*. As in all American forms of the genus only one set of laminae seems to be present in any individual, though the earliest set is formed at a very early age. In the European and Asiatic species several sets are usually present.

PLEUROCERATIDÆ.

Goniobasis comalensis Pilsbry. Figs. 24-28.

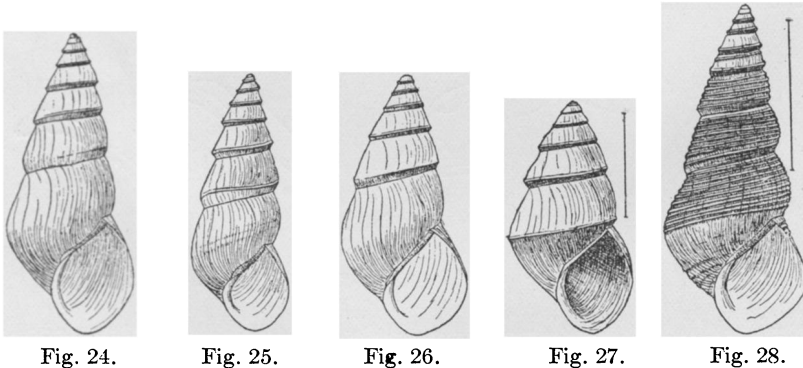
Melania rufa Lea?, Römer, Texas, p. 457 ("In den Quellen des Comal-Spring bei New Braunfels sehr häufig").

Melania pleuristriata Say, A. G. Weatherby [Wetherby] American Naturalist, April, 1878, p. 254, with var. *marmocki* (springs of southwestern Texas).

Goniobasis comalensis Pils., Nautilus, IV, p. 49, Sept., 1890 (Comal creek, New Braunfels).

G. pleuristriata Say and *G. comalensis* Pils., Singley, Contrib. Nat. Hist. Texas, Geol. Surv. Tex. Ann. Rep., 1892, pp. 311, 312.

Shell conic-turrite, thin but strong, covered with an olive-brown cuticle. Whorls of the spire with a distinct keel which projects a short distance above the suture, and is usually wanting on the last two



whorls; the whole surface showing fine sigmoid growth-striae, and in the best specimens very faint, minute, spiral striae. Aperture ovate, the outer lip thin, sigmoid, retracted below the upper insertion; basal lip rounded or subangular. Columella arcuate, somewhat thickened. Whorls about 7 in the most perfect shells, but usually fewer, the upper ones being eroded.

Length 18, diam. 7.3, aperture 7.3 mm.

Comal creek at New Braunfels, Comal county, Texas. Also in the

Guadalupe river 6 to 4 miles to the north; San Marcos river at San Marcos, Hays county, on the dam above the fish hatchery (Pilsbry and Ferriss; Singley); a variety from Bexar county (A. G. Wetherby).

This form differs from *Melania pluristriata* Say (*M. rubida* Lea) of central Mexico, by its far smaller size and less ample aperture. The type of *pluristriata* measured 1.25 x .55 inches; of *rubida* 1.30 x .57 inches; and the specimens from Lake Chapala examined by Dr. von Martens from 26 x 12 to 35 x 13 mm., while no Texan shell we have seen, in many hundreds examined, reaches 1 inch long. Von Martens refers the Mexican species to *Pachycheilus*. Dr. William H. Dall, to whom we submitted specimens of *G. comalensis* for comparison with the type of *M. rubida* Lea, writes that "though the general form is the same, the *rubida* is very much larger and perfectly distinct." The examples figured are from Comal creek, New Braunfels, near the mill.

The ascertained distribution of *G. comalensis* comprises only the short rivers of a single small system emptying into Espirito Santo Bay, intercalated between the Colorado and Nueces basins, and comprising the Guadalupe and San Antonio rivers and their tributaries.

The Goniobases are known from these streams only at the edge of the "Edwards Plateau." As they live on rocks, etc., in swift water, it is not likely that they approach much nearer to the Gulf. In the

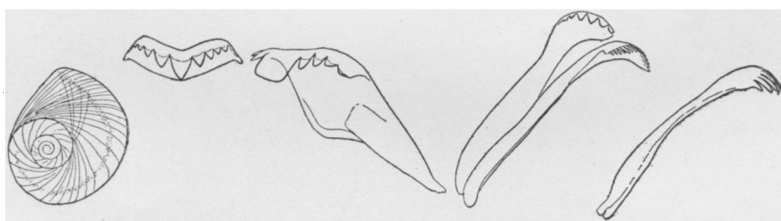


Fig. 29.

Fig. 30.

Fig. 31.

Colorado river, where Filsbry collected in 1885, nothing was seen of the species, nor has it been reported from the Nueces or its branches. We saw no sign of *Goniobasis* in the tributaries of the Rio Grande, where our collecting was extensive enough to have found it if it existed.¹²

The operculum (fig. 29) consists of about four whorls, the nucleus being situated at about the lower third of its length. It is closely

¹² In the collection of the Academy there are several specimens labelled "Dallas county," received from Mr. J. A. Singley. This is in the Trinity river drainage, but Singley in his catalogue of 1893, issued long after these specimens were placed in the collection, expressly states that he found the species nowhere but in Comal and Hays counties. There was probably some error in labelling the specimens.

marked with growth-wrinkles, and shows some striæ at right angles to them.

The radula (fig. 30) is normal for *Goniobasis*. The central tooth has 4, 1, 4 denticles, the inner lateral 2, 1, 4, inner uncinus 7, outer about 20 denticles. An inner uncinus in profile is drawn on the extreme right side (fig. 31), to show the length of the denticles, which are foreshortened in fig. 30.

G. comalensis is dimorphic, like *G. virginica* and many other species. At New Braunfels the smooth form described as typical predominates, but there are also some individuals with numerous acute spiral ridges, about fifteen on the last whorl, but often fewer by suppression of those just below the periphery.

At San Marcos only the smooth phase was found, in several hundred specimens taken.

A series of 12 labelled "Bexar county," received from A. G. Wetherby, consists wholly of multistriate shells, which moreover, although collected alive, are of a whitish or livid whitish tint, in this respect approaching the Mexican *pluristriatus*. The largest of this lot is 23.5 mm. long, 9.3 wide, exceeding in size any seen from Comal or Hays counties. These are part of the lot collected by Mr. G. W. Marmock, of Bexar county, and commented on by Wetherby in the *American Naturalist* for 1878. The "variety *marmocki*" mentioned by him, but without a word of definition, may have been the smooth form of the species, but there is nothing to indicate this either in Wetherby's note or the set of shells he sent to Tryon.¹³

Form **fontinalis**, nov. Figs. 32-35.

In a small spring in the pleasure garden near New Braunfels, one of the fountains of Comal creek, we found only very small shells, the largest 7 to 8.3 mm. long, 4.3 to 4.7 mm. wide, and of a markedly short, conic shape. The old ones are much eroded, and none are of the multistriate phase. This race inhabits only the springs and the rapid streams from them for a short distance down.

In another, much larger spring, and the stream from it for about fifty yards down, the shells are also dwarfs, though somewhat larger than those from the smaller spring.

These springs flow out of the limestone rock, the water being beautifully clear. It is not cold, being perceptibly warmer than the river at the time of our visit, about the middle of April. There is very little vegetation upon the rocks, and the small size of the snails may be due

¹³ Mr. Wetherby also mentions that "*Helix photus* Pfr." was collected by Mr. Marmock. This name may be an error for *H. tholus* W. G. B.



Fig. 32.



Fig. 33.



Fig. 34.



Fig. 35.

to insufficient food supply. Individuals are, however, very numerous. Associated with them are numerous *Physas*, also of pygmy proportions, though evidently adult. The snails of these springs evidently constitute physiologic rather than morphologic varieties.

AMNICOLIDÆ

Paludestrina seemanni (Ffld.).

New Mexico: South Spring creek, near Roswell, in a Pleistocene deposit (Cockerell and Tinsley, 1899).

Texas: Drift débris of Pecos river, about a mile above the High Bridge, Val Verde county (Pilsbry and Ferriss, 1903).

Dr. R. E. C. Stearns has recorded this species from Death valley, Inyo county, California. The specimens, some of which are before me, are somewhat more robust than those from New Mexico and Texas. The above records largely increase the eastward range of the species.

Paludestrina diaboli n. sp. Fig. 36.



Fig. 36.

Shell very slender, turrit, shaped about like *P. seemanni*; composed of $4\frac{1}{2}$ very convex whorls separated by a deep suture. Surface smooth. Aperture vertical, oval, a trifle narrower above than below, but not angular there. Peristome continuous, barely in contact with the preceding whorl for a short distance near the upper end. Umbilicus small but distinct.

Length 1.3, diam. .62 mm.

Drift débris of the Devil's river, about four miles from its mouth, Val Verde county, Texas. A single shell was also found on the Rio San Filipe near Del Rio, in the same county.

The shells were all taken dead and bleached. It is readily separable from *P. seemanni* by its diminutive size. This is the smallest species of its family known from North America.

***Amnicola comalensis* n. sp. Fig. 37.**

Shell distinctly perforate, ovate, thin, corneous, faintly marked with growth-lines. Spire regularly conic, the apex obtuse. Whorls $4\frac{1}{2}$, regularly convex, not shouldered, the suture well impressed. Aperture ovate, subangular above, the peristome adnate for a short distance above the perforation.

Length 3.9, diam. 2, length of aperture 1.3 mm.

Comal creek, near New Braunfels, Comal county, Texas. Also from the Guadalupe river about four miles above New Braunfels.

This species is much smaller than *A. limosa*, *decisa*, or other forms resembling it in color and shape. *A. cincinnatiensis* Anth. and the very closely related *A. peracuta* P. and W. both have more shouldered whorls, and are much larger than *A. comalensis*.

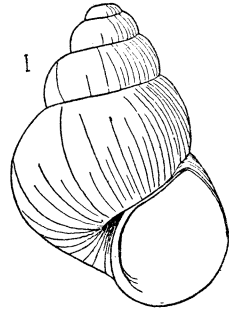


Fig. 37.

***Cochliopa riograndensis* n. sp. Pl. IX, figs. 10, 11, 12, 13.**

Shell of the usual depressed-turbinate shape, openly umbilicate, of a slightly olivaceous corneous tint. Surface faintly marked with growth-lines, and sculptured with unequal spiral threads, a few of the larger ones dark colored. One thread at the shoulder is usually the most prominent. In some shells the spirals are very weak, hardly perceptible. Whorls $3\frac{1}{2}$, moderately convex, flattened and sloping below the suture, elsewhere rounded. Aperture quite oblique, rotundly ovate, the peristome thin, equably arched except near the outer and columellar insertions where it is noticeably straightened. The ends are connected across the parietal wall by a thin or thick callus. The columella is not noticeably thickened.

Alt. 2, diam. 2.8 mm.

Alt. 1.65, diam. 2.65 mm.

Found in drift débris of Rio San Filipe near the Rio Grande, Val Verde county, Texas, thirty-six specimens. Pilsbry and Ferriss, 1903. Types, 91,324, A. N. S. Phila. A single shell was also picked out of similar débris on the Devil's river, about four miles from the Rio Grande, in the same county.

This discovery of this form adds a new genus to the fauna of the United States and greatly extends the distribution of the group, the

other species being Central American.¹⁴ The shell has much the appearance of *Valvata*, but is readily distinguished from that by its ovate, not circular aperture, which is more or less conspicuously angular above, and by having the whorls more compactly coiled. It should, however, be said that we could not verify the generic reference of *C. riograndensis* by examination of the operculum or radula, as unfortunately none of the shells we obtained were living, though some were fresh in appearance, and the operculum was not found. It consists of few whorls in *Cochliopa*, as in *Amnicola*, while that of *Valvata* is many-whorled with central nucleus.

C. riograndensis is not closely related to any of the known species, being of lighter texture, much more openly umbilicate, and with somewhat different sculpture.

VALVATIDÆ.

Valvata micra n. sp. Pl. IX, figs. 7, 8, 9.

Shell excessively small, composed of $2\frac{1}{2}$ tubular whorls; spire nearly flat; the last whorl is nearly round, barely or not quite in contact with the preceding at the aperture, near which it enlarges more rapidly. Suture deep. Surface finely, weakly striate. Aperture moderately oblique, subcircular, the peristome simple, continuous. Umbilicus ample but rapidly narrowing within.

Alt. .48, diam. 1.15 to 1.2 mm.

Drift débris of Guadalupe river about four miles above New Braunfels, collected by Pilsbry and Ferriss, 1903.

This is one of the smallest mollusks known, yet the dilation of the

¹⁴ Prof. von Martens defines four species of *Cochliopa* in the *Biologia Centrali Americana*—*guatemalensis* Morel., *tryoniana* Pils., *trochulus* and *infundibulum* Marts. (pp. 428, 429). He omits *C. rowelli* Tryon, which was originally described from Clear Lake, California. Rev. J. Rowell, who found the original specimens, now states (*in litt.*) that "*Cochlicopa Rowellii* was named from shells collected by me near Baulinas Bay (not Clear Lake), Marin county, California." There are authentic specimens from Central America in the collection of the Academy, so that I still doubt whether the species really was actually collected in California.

Prof. von Martens surmises that *C. guatemalensis* (Morel.), which he had not seen, may not be different specifically from *C. tryoniana*; but it is in fact not even closely related to that species, being very much smaller, more depressed, and evenly sculptured with threadlike spirals. The suture descends shortly in front in fully mature shells. An additional locality is Polvon, in western Nicaragua (McNiel in coll. A. N. S. Phila.). I have examined the radula of *C. guatemalensis* which proves to be Amnicoloid, and demonstrates the species to be a *Cochliopa*, not a *Valvata* as Morelet supposed. The central tooth has the formula $\frac{4.1.4}{3-3}$, the inner lateral has 6 denticles, the third from the inside being largest, and its body has the usual boss or projection below. The inner uncinus has 13, the outer very many excessively minute denticles.

whorl at the aperture shows it to be adult. Five specimens were taken. The shells are all more or less bleached, the freshest being of a pale corneous tint. The round whorls, deep suture and general appearance are quite unlike any *Planorbis* or *Vallonia*, and indicate, we think, either that it is a *Valvata* or an Amnicoloid snail comparable to *Horatia* Bgt. or *Daudebardiella* Bttg. in the Palæarctic fauna. Until fresh specimens with the soft parts or operculum are found, the position of this molluscan atom will remain uncertain.

Valvata micra nugax (pl. IX, fig. 6), a slightly larger form, alt. .9 diam. 1.5 mm., with three whorls and a projecting spire, may prove to be a distinct species; but for the present, until more specimens are found, it may be placed under *V. micra* as a variety or form.

CYRENIDÆ.

Pisidium singleyi Sterki.

Nautilus, XI, 1898, p. 112 (type loc. Guadalupe river, Comal county, Texas).

Drift débris of Guadalupe river about four miles above New Braunfels, and of Devil's river, Val Verde county, Texas. A closely related form was found near Del Rio.

Pisidium compressum Prime.

New Braunfels, Comal county, Texas. Mr. J. A. Singley found *P. trapezoideum* Sterki at the same place (coll. A. N. S. Phila. No. 60,127).

Pisidium abditum huachuacanum n. subsp.

The shell is quite inflated, dark brownish-olive, irregularly striate and marked with several conspicuous dark growth-arrest streaks; very inequilateral, the beaks low and near the anterior end. Anterior end abruptly truncate, posterior end produced and rounded. Hinge rather narrow, the lateral teeth in the right valve single, short and high, triangular; in the left double. Length 5.1, alt. 4.3, diam. 3.4 mm.

Stream in Carr canyon, Reef, Cochise county, Arizona, collected by C. R. Biedermann, February 8, 1904.

Specimens were submitted to Dr. V. Sterki, who could not identify the form with any known species. About half of the shells are more compressed than those described as typical, one measuring, length 4.1, alt. 3.4, diam. 2 mm. The very inequilateral, anteriorly truncate outline and low beaks are characteristic of both the obese and compressed forms.

Eupera singleyi (Pils.).

Sphærium (Limosina) singleyi Pils., Proc. A. N. S. Phila., 1889, p. 88, pl. 3, figs. 14, 15 (May 14, 1889).

? *Cyclas maculata* Morelet, 1859, not of Anton, 1839 = *Sphærium yacatanense* Fischer and Crosse, Miss. Sci. Mex., Moll., II, p. 653 (1894).

This species is now known to us by specimens from the following

places, all in Texas: White Oak bayou, Houston (Singley); Cedar creek, Hudson county (G. C. Heron, type locality); Lavaca river, Jackson county (J. D. Mitchell); New Braunfels, Comal county (Singley, Ferriss and Pilsbry); Guadalupe river about four miles above New Braunfels (Singley, Ferriss and Pilsbry); Devil's river, Val Verde county (Ferriss and Pilsbry).

It is a prettily maculate little clam, widely distributed in Texan waters. The largest shell I have seen measures 6 mm. long. It may prove to be specifically identical with *E. maculata* Morelet of Yucatan, but that name is preoccupied by Anton for another species of the same group. Both were described as *Cyclas* and belong to *Eupera*. For this reason Crosse and Fischer proposed to substitute the name *yucatanense*; but five years previously I had described and figured *S. singleyi*. The latter name will therefore stand.

UNIONIDÆ.

A list of species taken by us in Arkansas, Indian Territory and Texas will be published elsewhere. As our work in these States was done in the early spring, we found most of the streams too high for effective collecting of bivalves.

EXPLANATION OF PLATES V-IX.

PLATE V.—Figs. 1, 2, 3.—*Polygyra mooreana tholus* (W. G. B.). Washington county, Texas. No. 251, A. N. S. Phila.

Figs. 4, 5, 6, 7.—*Polygyra mooreana* (W. G. B.). Guadalupe river, Comal county, Texas. No. 91,364. Figs. 8, 9, 10.—Hondo river near Hondo, Texas. No. 91,361.

Figs. 11, 12.—*Polygyra texasiana texensis* Pils. Types. Colorado City, Texas. No. 83,258.

Figs. 13, 14, 15.—*Polygyra texasiana hyperolia* Pils. and Ferr. West of Devil's river, Texas. No. 91,363.

Figs. 16, 17, 20.—*Polygyra texasiana* (Moric.). Typical. Guadalupe river Comal county, Texas. No. 91,362.

Figs. 18, 19.—*Polygyra texasiana* (Moric.). Race with striate base, Calhoun county, Texas. No. 229, A. N. S. Phila.

PLATE VI.—Fig. 1.—*Bulimulus dealbatus mooreanus* (W. G. B.). San Antonio, Texas. No. 84,626.

Figs. 2, 3, 4.—*B. d. mooreanus*. Guadalupe river above New Braunfels. No. 84,628.

Figs. 5, 6.—*B. d. mooreanus*. Victoria, Texas. No. 76,210.

Figs. 7, 8.—*B. d. liquabilis* (Rve.). San Marcos, Texas. Nos. 91,396 and 91,397.

Figs. 9, 10, 11.—*B. d. liquabilis*. Jackson county, Texas. No. 76,286.

Fig. 12.—*B. d. liquabilis*. Lee county, Texas. No. 58,379.

Fig. 13.—*Bulimulus dealbatus* (Say). Type. No. 58,381, A. N. S. Phila. Alabama.

- Fig. 14.—*Bulimulus d. ozarkensis* Pils. and Ferr. Seligman, Missouri. No. 83,132.
 Fig. 15.—*B. d. ozarkensis* Pils. and Ferr. Rogers, Arkansas. No. 91,358.
 Figs. 16, 17.—*Bulimulus d. ragsdalei* Pils. Types. Montague county, Texas. No. 58,380.
 Figs. 18, 19, 20, 21, 22.—*B. d. ragsdalei*. Southwestern herd. West of Devil's river, Val Verde county, Texas. Nos. 91,356 and 84,638.
 Figs. 23, 24.—*B. d. ragsdalei* Southwestern herd. Del Rio, Texas. Nos. 87,486 and 91,355.
 Fig. 25.—*Bulimulus d. pasonis* Pils. Type. Near El Paso, Texas. No. 83,259.
 Figs. 26, 27.—*Bulimulus d. pecosensis* Pils. and Ferr. Near the Pecos river. Nos. 91,359 and 84,618.

PLATE VII.—Varieties of *Bulimulus alternatus mariae* (Alb.).

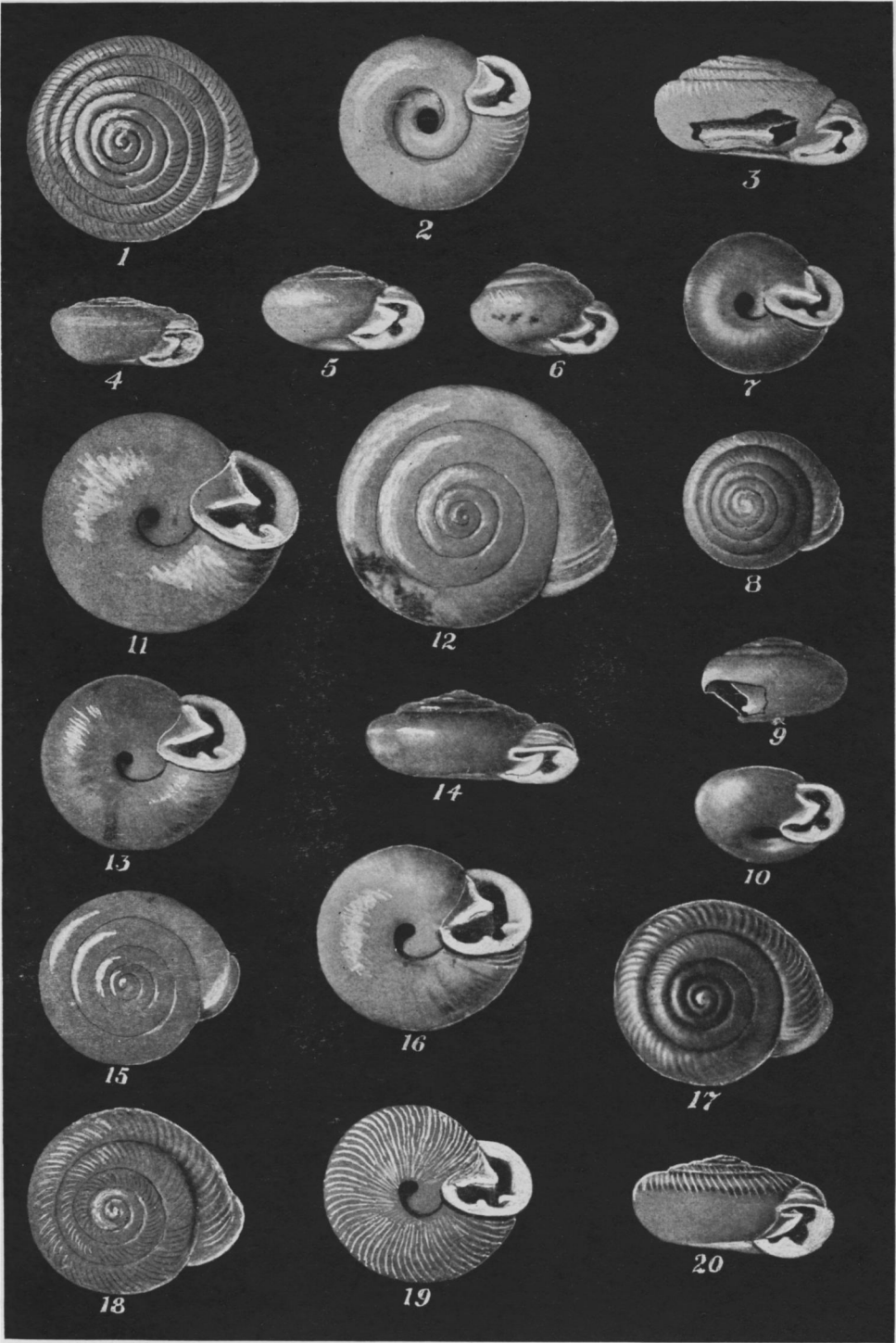
- Figs. 1-7.—Near the High Bridge of the Pecos. No. 84,627, A. N. S. Phila.
 Figs. 4 and 5 represent young shells.
 Fig. 8.—Near the Rio Grande, east of the Pecos river. No. 84,625.
 Figs. 9, 10, 11.—Near Rio San Filipe below Del Rio. No. 84,635.
 Fig. 12.—Near Rio San Filipe below Del Rio. An albino, taken alive.
 Figs. 13, 14, 15, 16.—Corpus Christi, Texas. No. 60,136.
 Figs. 17, 18, 19.—Hidalgo, Texas. No. 60,094.
 Figs. 20-24.—Derby, Frio county, Texas. No. 60,501.
 Figs. 25-30.—Laredo, Webb county, Texas. No. 60,502.

PLATE VIII.—Figs. 1, 2, 3.—*Helicodiscus eigenmanni* Pils. San Marcos, Texas. No. 91,320.

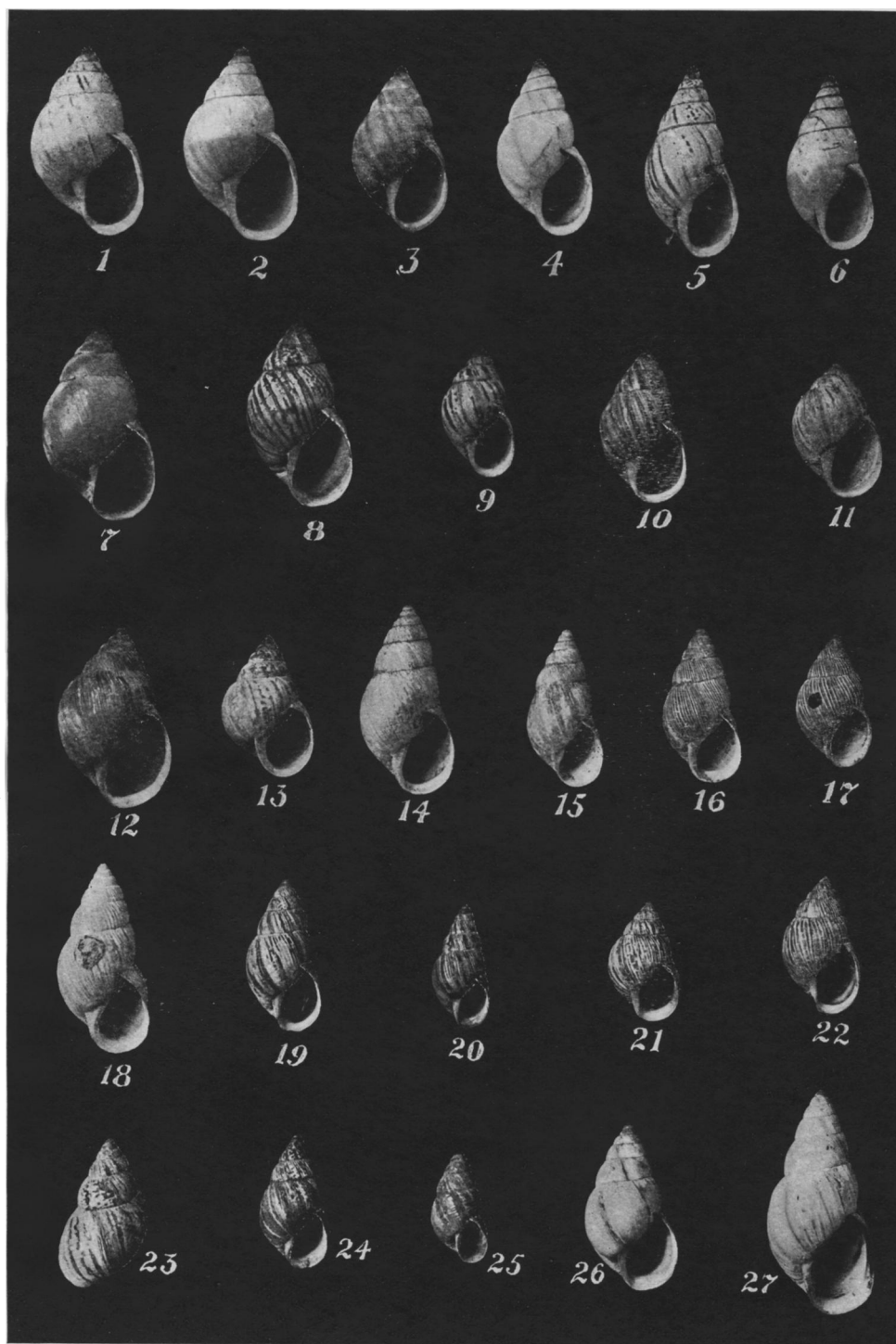
- Figs. 4, 6.—*H. e. arizonensis* Pils. and Ferr. Fort Bowie, Cochise county, Arizona. No. 87,077, A. N. S. Phila.
 Fig. 5.—*H. e. arizonensis*. A more depressed specimen. Cave Creek Canyon, Chiricahua Mountains. No. 87,076. A. S. N. Phila.
 Figs. 7, 8, 9, 10.—*Helicodiscus parallelus* (Say). Philadelphia, Pa. No. 78,272, A. N. S. Phila.

PLATE IX.—Figs. 1, 2, 3.—*Planorbis filocinctus* Pils. and Ferr. Type.

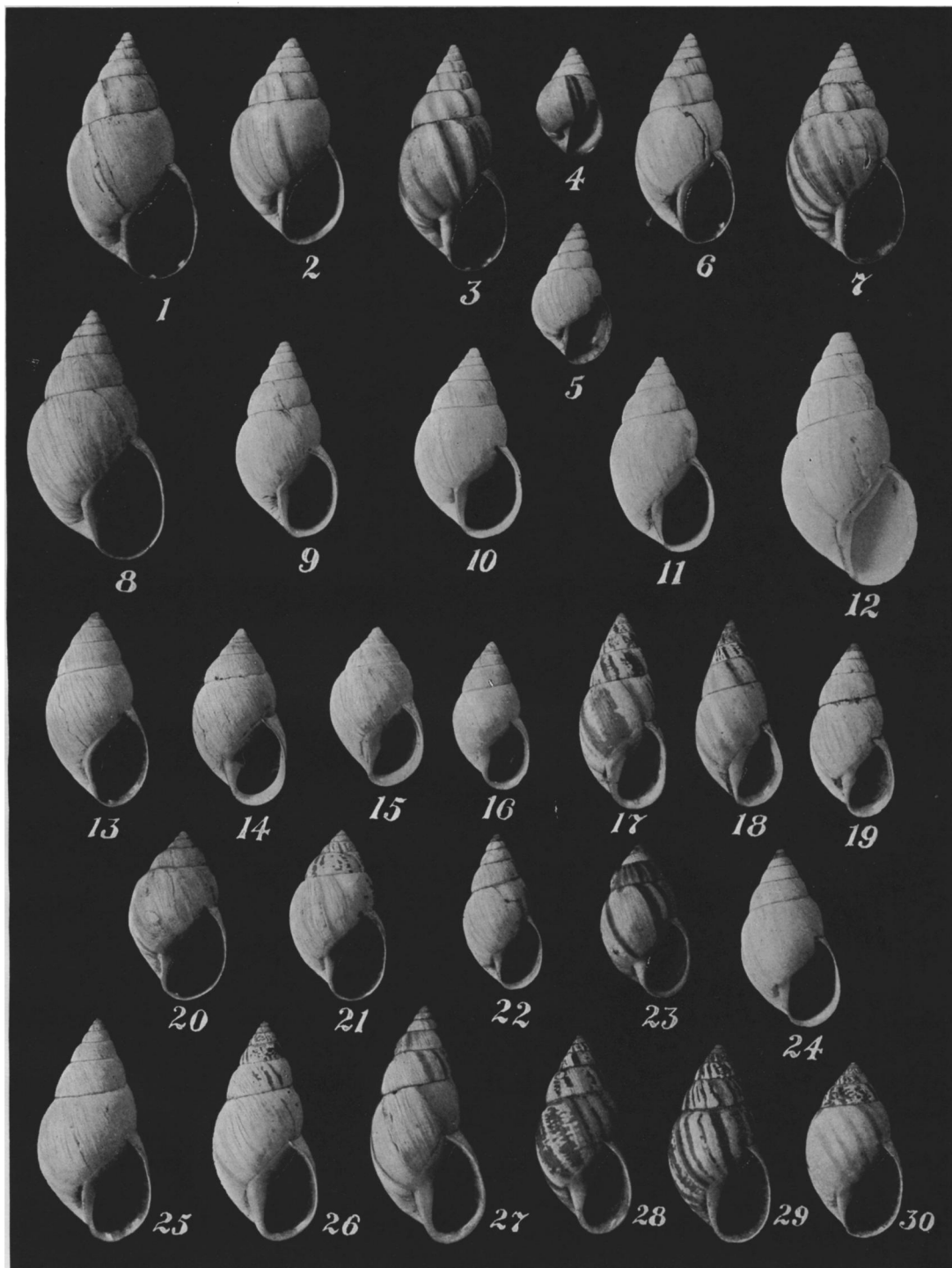
- Figs. 4, 5.—*Planorbis carus* Pils. and Ferr. Type.
 Fig. 6.—*Valvata micra nugax* Pils. and Ferr. Type.
 Figs. 7, 8, 9.—*Valvata micra* Pils. and Ferr. Type.
 Figs. 10, 11, 12, 13.—*Cochliopa riograndensis* Pils. and Ferr. Cotypes.



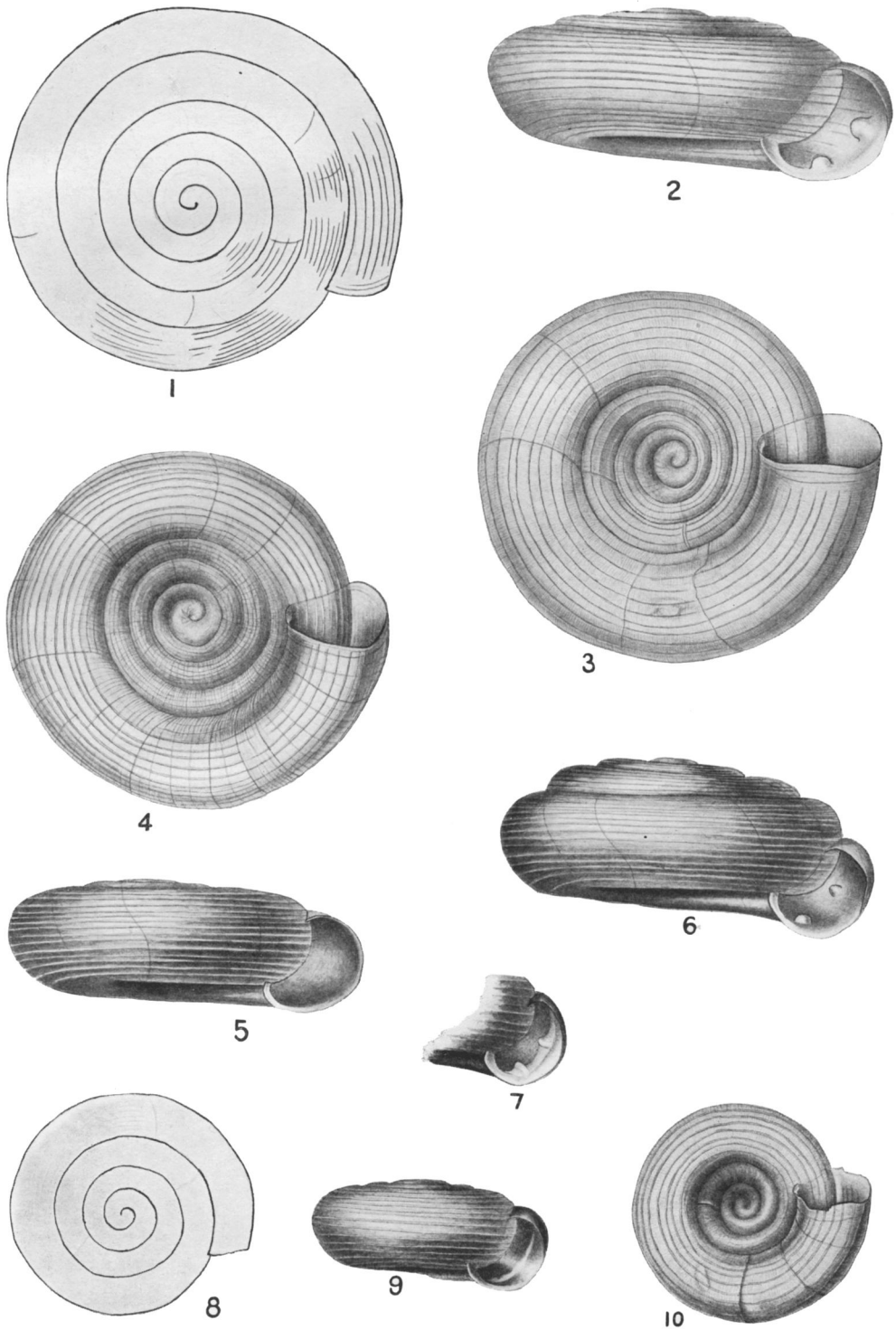
PILSBRY AND FERRISS. MOLLUSCA OF SOUTHWESTERN STATES.



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